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THE UNIVERSITY OF ALBERTA

SHORT TERM RETENTION ABILITY AND READING ACHIEVEMENT AMONG FOURTH GRADE STUDENTS

by

© PATRICIA JOHNSON-HOETKER

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "Short Term Retention Ability and Reading Achievement Among Fourth Grade Students" submitted by Patricia Johnson-Hoetker in partial fulfillment for the degree of Master of Education.

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ABSTRACT

Reading is a complex process that involves a host of operations. Many researchers (Mackworth, 1972; Underwood, 1960; Smith, 1971) believe that the short term memory is one such operation that enables the reading process to progress smoothly. The purpose of this study was to investigate the existence of a relationship between immediate visual memory and reading achievement and the affects of socio-economic and visual discrimination factors on memory and reading achievement.

The sample consisted of 78 white fourth grade children of average intelligence who spoke English as their first language from the Edmonton public and separate school systems. Thirty-eight children were from a school designated as a middle socio-economic area and forty children were of low socio-economic status as determined by the Blischen Occupation Index Scale and the Doll Questionnaire.

Five diffefent tests were used to note the relationship among reading, memory, and visual discrimination. The Gates-MacGinitie Reading Test Survey D form 1M was used to assess reading achievement and divide the sample into high, average and low reading achievement groups. Immediate memory for letters was assessed by a standardized Letter Memory Test; immediate memory for words by Woychuk's Word Memory Test; and visual discrimination by a modified form of the Huelsman Visual Discrimination Test. The Nonsense Word Test was constructed by the researcher to identify organizational strategies used during the act of reading.

Mainly the study found correlations between short term memory and reading achievement as measured by the Gates-MacGinite Reading Test and between certain organizing strategies and reading achievement.

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Chapter I

INTRODUCTION AND PROBLEM

Individuals form impressions about their world via receptor systems that bring information to the memory system. Meaning-giving perceptions are first stored for a few seconds in the short term visual memory, where they are either rejected or identified; and if identified, classified and placed in permanent memory.

Calfee (1970) cites research suggesting that visual memory may be an important factor in many areas of the learning process. In the process of reading, for example, the child must be able to recall information that has been presented visually. In the very beginning stages of learning to read memory processes are vital.

Money (1966) stated that learning the letters of the alphabet involves a memory task of building up an inventory of the different symbols and developing a concept of the identity and constancy of each symbol. If a child has a poor visual memory, he may have difficulty differentiating among the letters of the alphabet.

While retention ability for various stimuli has been the subject of many studies, few of these have related retention ability to reading. Those that have examined the relationship include Guthrie and Goldberg (1972), who looked at visual sequential memory and its correlation with reading ability. Their design included a partial

correlation which removed chronological age as a variable. The results indicated that the Benton Visual Retention Test showed more correlation with reading then all of the other tests combined. All of the tests required the use of visual memory, but the Benton Test required the subject to remember both form and attitude as well as the sequence of the stimuli. During the reading act it is similarly necessary to remember form (the specific letters), attitude (rotations such as d and b), and the sequence of the letters (pat versus tap). The major finding of the study, and the one most pertinent to the present study, was that tests of visual sequential memory correlated significantly with several aspects of reading.

Two other studies, Froehlich (1970) and Noelker (1973), demonstrated a significant correlation between reading achievement and visual memory for designs having form, orientation and sequence components. Although geometric designs do have some physical commonalities (direction, rotation) with the recognition of letters, it may be questioned whether retention of forms and designs directly relates to the reading act.

To bring memory studies closer to reading, Woychuk (1973) investigated short term memory for digits, forms, letters and words. In her sample of fifty achieving and non-achieving third graders, Woychuk found that immediate memory for letters correlated the highest with reading achievement. Memory for words correlated the next highest. Thus it seems that researching the relationship between stimuli, such as letters and words that are involved in the reading act, may yield insights about short term visual memory and reading success.

Fundamental to the memory processes are the components of acquisition and retrieval. Facilitating the performance of the above components are the pupils' organizing strategies. Piaget (1968) in his extensive work on memory and intelligence cites two prevailing beliefs about memory.

> For some the memory is nothing but retention or reactivation and hence an instrument of pure conservation quite distinct from the intelligence in its various modes of adaption to novel processes; for others it is a form of organization which, though mainly figurative, rests on the general schematism of the intelligence (p, 379).

The present study will look at the organizational aspect of memory and its affect upon children's reading strategies.

After perusing much of the literature on immediate visual memory, the researcher concluded that the following questions needed to be investigated; Is there any relationship between visual memory and reading achievement? Are certain stimuli easier to retain than others? Does socio-economic background affect retention ability? Do the organizational components of memory influence reading achievement? The present study is intended as a contribution to the answering of these questions.

I. Purpose

The main purpose of the study was designed to examine the retention ability of high, average and low readers of low and middle socio - economic status to determine if an differences existed in their ability to recall various stimuli and in their ability to organize

units for recall as measured by the Letter, Word and Nonsense Word Tests. A secondary purpose was to assess visual discrimination ability and its influence on reading and memory processes.

II. Definition of Terms

Short Term Visual Memory. For this study, short term visual memory is is defined as retention over a five second period.

Visual Memory Span. Visual memory span refers to the ability of the individual to verbally or graphically reproduce immediately after presentation a sequence of stimuli in the original order.

High Reading Achievers. Individuals scoring in the top third on the Gates-MacGinitie Reading Test.

Average Reading Achievers. Individuals scoring in the middle third on the Gates-MacGinitie Reading Test.

Low Reading Achievers. Individuals scoring in the bottom third on the Gates-MacGinitie Reading Test.

Letter Memory Test.* This is the Visual Attention Span for Letters subtest of the Detroit Tests of Learning Aptitude. It consists of seven sets of letters with two trials in each set. The sets increase from two to seven letters. The test was designed to measure recall capacity for letters immediately following presentation.

Word Memory Test.* This test consists of eight sets of monosyllabic words. The sets increase in length from two to nine words. This test was also designed to measure one's ability to recall words

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*These tests are described in chapter three and are reproduced in the appendix.

in original order immediately after presentation.

Nonsense Word Test.* The Nonsense Test consists of 20 one, two and three syllable words that have no meaning to fourth grade children. This test was designed to measure immediate memory and specifically to examine students' abilities to organize input for immediate recall.

Middle Socio-Economic School.** The school where (1) the majority of the children's fathers scored 40 or above on the Blischen Occupational Index Scale; and where, also, (2) the majority of teachers so rated it according to Doll's checklist (Havighurst, 1966).

Low Socio-Economic School. The school where (1) the majority of the children's fathers scored 39 or below on the Blischen Occupational Index Scale; and where, also, (2) the majority of teachers so rated it according to Doll's checklist.

III. Hypothesis

Null Hypothesis One

When the obtained means are compared using an Analysis of Variance procedure, there is no significant difference between the scores obtained by high, average and low reading achievers on these tests:

a) Nonsense Word Test
b) Word Memory Test
b) Letter Memory Test

**The schools were initially suggested by the Director of Research Studies in the Edmonton Public School System and the Reading Curriculum Coordinator of the Edmonton Separate School System.

Null Hypothesis Two

There is no significant difference as measured by the Analysis of Variance procedure between the middle (school 1) and low (school 2) socioeconomic schools on mean scores obtained from these tests:

a) Gates-MacGinitie Reading Test;
b) Nonsense Word Test;
c) Word Memory Test; and
d) Letter Memory Test.

Null Hypothesis Three

There is no significant correlation (Pearson's r) between Gates-MacGinitie Reading scores and scores on the:

a) Nonsense Word Test;
b) Word Memory Test
c) Letter Memory Test
d) Visual Discrimination Test

Null Hypothesis Four

When the obtained means are compared using the test analysis or variance procedure, there is no significant difference between mean scores of the high, average, and low readers on the Visual Discrimination Test.

IV. Limitations

The findings of this study are limited because:

1. The students tested for this study were of only one grade level and from two schools and therefore were not representative of the total school population.

2. The number of students involved in each achievement group was relatively small, thus limiting the generalizability of the results.

3. The basic criterion for identifying the two schools was the Blischen Occupational Index Scale. This scale does not take into account the education or occupation of the mother, which may act to provide an extra income to many families or in some cases is the only means of support.

4. In the case of the Nonsense Word Test, the method of teaching beginning reading may have influenced the children's approach to the test and hence their scores.

5. Because the study was concerned only with the visual modality, allowances were not made for pupils who learn better via another mode.

V. Significance of the Study

The main significance of this study was the possible insights it may have yielded into the process of visual short term retention and its relationship to reading achievement. If it were found that reading achievers perform better on the memory tasks than those who read with difficulty, then retention ability may be a factor the teacher should consider when investigating reading difficulties.

More specifically if it were found that the organizational factor in memory processes was beneficial to the reading act then programs could be developed that would teach children to group letters, words, and phrases during reading to aid the memory process and encourage fluent reading.

In addition, if the study revealed any differences in the relationship of socio-economic factors, reading achievement and memory tasks, the further investigations may be in order to ascertain possible factors and to plan useful experiences that would narrow the differences.

The study may also help to identify which memory task would be a better indicator of reading success. If certain memory tasks are found to relate more closely to reading achievement than others, methods may be devised on the basis of the memory tests that will improve visual memory and hopefully influence reading performance.

VI. Overview of the Investigation

The investigation was reported according to the following plan.

Chapter II discusses a theoretical basis for the relationship of short term memory to reading achievement. Research pertinent to the study was reported.

Chapter III outlines the design of the study and gives details about the sample, memory tests and analyses of the data.

Chapter IV analyzes and explains the results of the study, while Chapter V presents the summary, conclusions and implications of the findings.

Chapter II

REVIEW OF THE RESEARCH

This chapter attempts to review selective literature regarding visual short term memory as it relates to reading achievement and the nature of immediate memory processes. From this review conclusions were drawn that recognized the importance of studies investigating memory processes that related to the reading act, specifically to cognitive organizational ability and reading achievement.

From the myriad studies in the literature regarding memory, only those that yielded understanding of the process, per se, and those that related immediate memory to reading were included. Many studies, psychological and biological in nature, have analyzed the memory processes in light of their particular interests but few studies have examined the role of short term memory in the reading process. By looking at studies of varying orientations it was hoped that more understanding of the complex problem of memory and its function in the reading act could be gained.

The first section of this chapter briefly discusses the characteristics of memory processes. The second part examines immediate memory, specifically organizational factors involved in retention. The third section attempts to focus directly on research relating short term memory to reading behavior. The influence of visual discrimination on memory and reading achievement is discussed in the fourth section. Socio-economic variables and their relationship to reading achievement follows in the last section.

I. General Characteristics of the Memory Mechanism

Discussions of memory have usually centered on the physical aspects such as initial stimuli, storage mechanisms and retrieval processes. Each has been called a fundamental component of memory.

Frank Smith (1971) has outlined three phases of memory which explain the place of short term memory in the general concept of memory.

(1) Sensory store (a visual image)

The perception is briefly retained while the information processing operations begin. Information decays in less than a second probably erased by incoming information.

(2) Short Term Memory

The short term memory has a limited capacity of about four or five separate items which are held while being classified or categorized. The actual time the image is available for processing is short because the reader keeps bringing in new information. The initial input may be lost if not disposed of before more information enters the processing apparatus.

(3) Long Term Memory

Relevant information, information from the short term memory that has been matched to the data bank of the long term or permanent memory is then pressed into the long-term or permanent memory. The reader is able

> to do this because he has already acquired from his vicarious and actual living experiences, competence to predict what the nature and relevance of incoming information will be. This selection occurs at what Smith calls the preconscious level. Two limitations of the long term memory are; the time involved securing information into it and the need for procedures to get the information out. In the processing of visual information short term memory is an important and necessary link between the perceptual act, the permanent store and therefore the retrieval mechanism.

There has been some inconsistency in the research regarding the inclusion of the initial stimuli, the action or event that results in something being stored, as a viable part of a theory of memory.

Melton (1967) limits his theory of memory to " . . . that position concerned with the storage and retrieval of the residues of demonstrable instances of association formation (p. 298)." Stimuli traces are excluded on the belief that the initial sensory trace is so fleeting that it may not register or become part of the memory trace system. Melton seems to be saying that the type or form of the incoming information does not influence retrieval strategies. Experiments with nonsense syllables, digits and letters have been shown to cause different effects on retention ability.

Underwood and Postman (1960) investigated retention ability for various serial lists composed of simple words and nonsense trigrams. Specifically they were interested in extraexperimental sources of interference. One source of interference was the subject's expectance of certain letter sequences. It may be difficult to learn a syllable composed of the letters MZD because the sequence is not a familiar pattern in the language. If the stimulus does not influence retention then it would seem that the pupils would experience as little difficulty in recalling nonsense words as simple words. One of these findings showed that immediate recall is higher for the two lists of simple words than for the two lists of trigrams indicating that the stimuli do affect the amount of recall.

Another investigation into short term memory for various stimuli was conducted by Woychuk (1973). She examined the retention ability of achieving and non-achieving third grade readers. She concluded that both groups recalled digits easier than words, letters or forms. Within each group a hierarchical pattern for retention was exhibited demonstrating the importance of stimuli on recall ability.

The nature of the stimuli is one measureable aspect identified as part of the total memory process. Interacting with the stimuli are the processes of storage and retrieval.

Bartz (1968) claims that memory is a process of reconstruction as much as it is a storehouse of experience. Bartz looks at memory in terms of an associative and an information process of learning of which

the latter appears currently to be the more accepted of the two. The associative process consists of forming associative bonds between stimuli and response. Memory in a serial recall task for example is a consequence of the formation of bonds with items near it. The preceding stimulus in effect influences the following link. A meaning of a word for example, consists of the chain of associations which it arouses. The meaning could not be gained until such a sequence had occurred. The information processing theory is analagous to what Bartz called operating a library. The focus of this view is on the retrieval of information and the learner's strategy for remembering.

The information processing theory of memory contributes to Venezky and Calfee's (1970) analysis of memory as indicated in a model of the reading act (Figure 1). They also view the learner's strategy for remembering to be an important influence on recall. Venezky and Calfee's model includes a high speed visual scanning device and two simultaneous processing forms; (a) syntactic-semantic integration of what has just been scanned, and (b) forward scanning to locate what is called the next Largest Manageable Unit (LMU). The LMU's are ". .the largest units that can be chunked rapidly and may be single letters, strings of letters, words, or phrases (p. 274)." Searching for the LMU implies an organizational aspect that may influence retention ability. The organizational influence will be discussed in the next section.

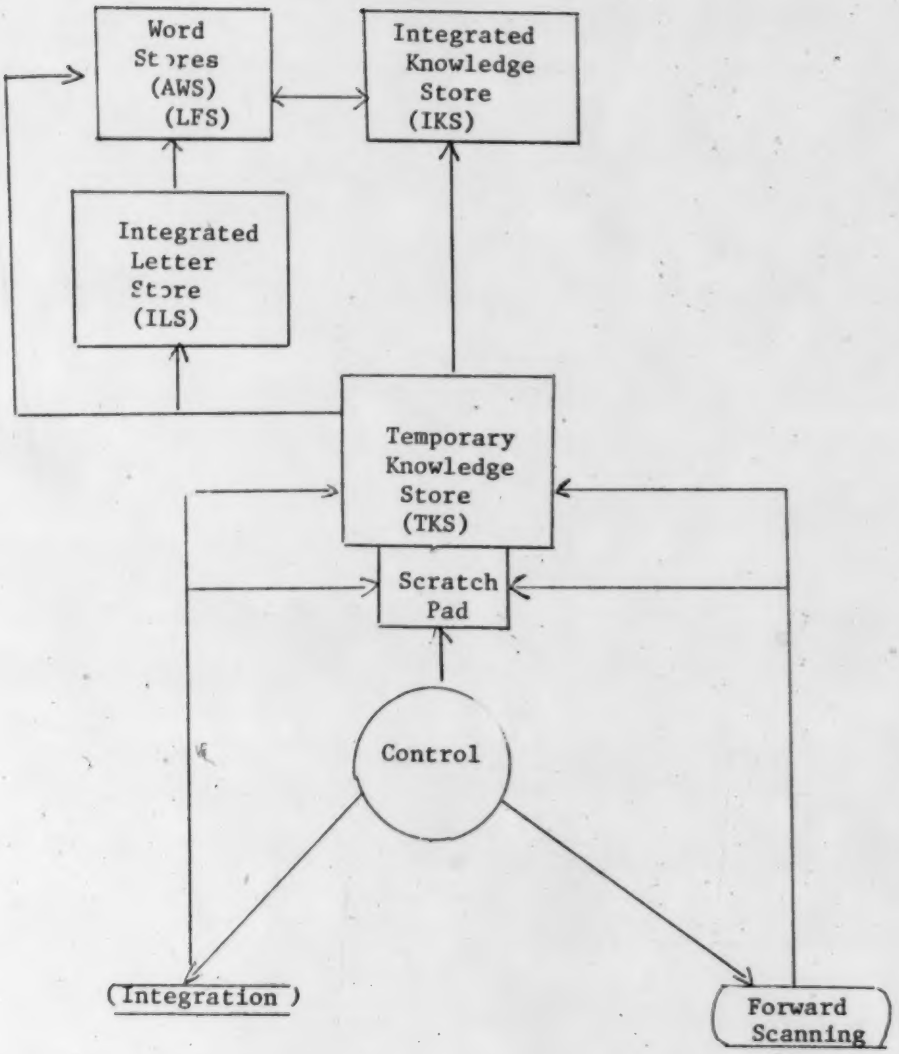


Figure 1

Model of the Reading Process
(Venezky & Calfee, 1970, p. 277)

Summary

(1) Dialogue continues in memory research as to whether initial stimuli traces should be included in a theory of memory.

(2) Retention ability appears to be influenced by the nature of the stimuli.

(3) Memory as an information rather than as associative band process appears to be more convincingly supported by research.

(4) Memory processes may utilize an organizational mechanism.

II. Organization and Retrieval

Sundry factors which may affect the retrieval processes are: speed of incoming information, interference or decay of the memory trace and repetition. Blankenship (1938) has divided other factors affecting the memory process into extrinsic and intrinsic ones. Age, sex and pathological condition of an individual are representative of the intrinsic category and characteristics of the material used such as rhythm and rate of presentation, fatigue and attitude of the subject are classified as extrinsic factors. He also identified association (seeing relationships among a series to reproduce the items) and imagery as elements influencing memory.

Howe (1970) and Spache (1967) also single out attention factors of the material and of the student as possible influences on perception. Lawton (1968) investigated facets of motivation as possible

influences on the problem of educational underachievement in working class students. A positive attitude and physical and mental set may affect a child's retention ability.

Information may be forgotten due to interference of other incoming data or decay in the short term memory trace. One possible influencing factor in addition to decay or interference is inefficient organization or grouping of the stimuli by the reader.

Calfee (1970) found that poorer performance of retardates was due not to a limited capacity of the short or long term memory nor to a faster rate of information decay, but in the retardates inability to organize stimuli effectively to aid performance. Calfee is in agreement with Bernbach's conclusion, that differences in short term memory between adults and children arose because adults automatically attach labels to stimuli where children have to be directed to do this. Calfee's conclusion is consistent with Anderson's (1970) findings in that the poor readers were as successful as the good readers in identifying new stimuli but not in detecting old stimuli. Anderson suggested that ". . . some kind of label, not necessarily verbal but internally integrated and consistent is necessary for stimulus recognition (p. 89)." If the system for recognition is not consistent the search into memory will not locate it.

Tulving (1962) looked at organization in an unspecified recall of 'unrelated words' experiments. The words were not in the form of a gramatically nor semantically correct sentence. He found that

his subjects imposed a sequential structure on a list of sixteen words illustrating a positive correlation between organization and performance.

The catalyst responsible for the surge of experiments investigating organization strategies and memory was the paper, "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information" by George Miller (1956). Miller's experiments lead him to believe that when investigating immediate memory ". . . we must recognize the importance of grouping or organizing the input sequence into units or chunks. Since the memory span is a fixed number of chunks, we can increase the number of bits of information that it contains simply by building larger and larger chunks, each chunk containing more information than before (p. 93)." Essentially the process involves recoding. The subject regroups the input events, applies a new name or label to the group and then remembers the new label rather than the specific original input events.

Miller (1956) cites an experiment reported by Sidney Smith before the Eastern Psychological Association in 1954 for grouping and renaming digits. First 18 binary digits are shown. This sequence of numbers is too large to remember. These numbers are then grouped by pairs; for example, 00 is renamed 0, 01 is renamed 1, etc. Recoding more bits into a chunk, groups the binary digits into a form that can be retained by the immediate memory. Miller suggests that the process of memorizing may simply be the formation of chunks, or groups of items that go together, until there are few enough chunks so that we can recall the items.

Miller's new insights appear very encouraging in light of the limitations of the immediate memory. It is possible to stretch the physical limitations by ". . . organizing the stimulus input simultaneously into several dimensions and successively into a sequence of chunks . . . (p. 95)." Organizing different stimuli may necessitate flexible encoding strategies.

Organization in Language

Probably the most obvious pattern of organization is found within the constraints of any language. Miller & Selfridge (1950) were interested in the influence verbal context would have on the recall of meaningful material. They defined verbal context as ". . . the extent to which the choice of a particular word depends upon the words that precede it (p. 177)." They composed lists of unrelated words from 0-order approximation (a sequence of words that will probably never follow one another) to the English language to 7-order approximations. The meaningfull material was taken directly from a textbook. Examples of the lists follow:

0-order	-	byway consequence handsomely financier bent flux ...
7-order	-	recognize her abilities in music after he scolded her before
meaningful	-	the history of California is largely that of a railroad.

All of the approximations were considered nonsense material by the researchers except those taken from the text. Each approximation may be considered meaningful as far as each word itself denotes meaning but grouped together as a sentence the 0 to 7-order approximations do not compose a complete thought.

The results showed that recall ability increased as the order of approximation increased and decreased as the length of the list increased. Because of another interesting discovery, Miller & Selfridge also noted that a clear distinction between nonsense and meaningful sentences is not as important a distinction as one between material that has kept phrases intact maintaining some associative value and those that haven't. Extended nonsense sentences such as 'house to ask for is to earn our living by working towards a goal for his team is old New York was a wonderful place wasn't it...' proved to be as easy to remember as sentences taken directly from a book. The researchers suggested that the nonsense sentences made use of phrase units and thus retained short range associations. Subjects were able to associate past experiences or learning with, for example, the phrase 'earn our living by working towards a goal' and therefore were able to recall the phrase with little difficulty. If a system of organization is used such as phrase units even nonsense material can be recalled. Structuring words into phrase units for immediate recall is not unlike organizing letters into syllables for immediate word recall. The above study suggests that with a greater amount of structure or organization present in the material, immediate recall is improved.

Akin to Miller & Selfridge's work, Epstein also was interested in language constraints and learning. Epstein (1961) worked with 192 college students to determine the role of syntax in verbal learning. He was intrigued with the question, What is it about a sentence that enables people to recognize it as a sentence and compose an accepted one of their own? Epstein reasoned that a sentence is more than a

highly probable sequence of words; more than a random grouping of familiar words; and even more than the meaning it imparted.. It appeared that what allows a sentence to transmit meaning is its grammatical structure or syntax. Epstein defined syntax as ". . . the generalized pattern or schema which is imposed upon the reservoir of available words and determines the sequences of these words (p. 80)."

To determine the influence of grammatical structure on a recognition and reproduction memory task apart from meaningfulness, Epstein compared the learning of nonsense sequences that retained proper grammatical inflections, for example, 'a vap koob desak the citar molent um glox nerf' with matched word sequences with the grammatical additions such as plurals (s) past tense verbs (ed) and adverbs (ly): 'A vapy koobs desaked the citar molently um glox nerfs.'

Epstein's results strongly indicated that the structured series of words were less difficult to learn than the unstructured ones. This suggests that syntax definitely aided the learning involved in the task. Two of the explanations given by Epstein are of particular interest to this study.

Epstein turns to Miller's examination of the immediate memory span referring specifically to his chunking or reorganization theory discussed earlier in the present study. Epstein concludes that ". . . material which is not syntactically structured may be harder to learn than structured material because the latter is already organized whereas the former can be organized into more efficient chunks only through the

intentional efforts of the learner (p. 84)." If the series of words to be learned is already organized syntactically, the immediate memory span's load is lightened by this chunking effect.

The second explanation of interest centers on the different strategies subjects might employ during the structured and unstructured memory tasks. In an unstructured task (not syntactically organized) the subject may try to remember the words randomly or unsystematically and recall will be inefficient. If the material makes use of syntax then Epstein suggests that ". . : the presence of patterning may encourage a more systematic approach leading to more rapid learning (p. 84)."

The above two explanations of chunking and organizational strategies may also be applied to the act of reading. When a reader encounters an unfamiliar word and uses an inefficient decoding strategy such as a letter by letter analysis, the immediate memory may not be able to retain the correct sequence of letters long enough for the word to be processed into the permanent memory and recognized. If the reader uses a chunking method such as recoding letters into syllables when reading, the immediate memory needs only to retain the larger bits of information rather than the individual letters and matching and recognition are faster. The act of reading therefore becomes more fluent.

Corroborating Epstein's and Miller and Selfridge's results was an experiment by Rosenberg (1968) who tested the importance or use of phrase structure and association in sentence recall tasks. He chose sentences that were high and low in associational value. Examples of high (HA) and low (LA) association sentences respectively are: The old king ruled wisely, and The poor king dined gravely. Rosenberg

found that nouns were retained the easiest in the LA sentence and nouns and verbs in the HA sentence. The general implications of his findings suggest that the syntax and associative or meaning structure of the sentence aid in the learning of the sentence. One would tend more often to associate ruling wisely with a king than dining gravely. Using logical syntactical boundaries as an organizing strategy lightens the memory load (fewer chunks) but increases the amount of information per chunk.

Mackworth (1972) appears to allude to syntax in her discussion of memory when referring specifically to hierarchical probabilities. She contends that memory for a series of items depends on factors such as probability (something will follow another thing consistently), familiarity and the number of items. It seems necessary that language probabilities between letters, words and phrases should be stressed in the teaching of reading.

Consistent with Mackworth's views on language and memory are the illations drawn by Miller et al. (1954) and Postman (1964) from their investigations. Miller et al. studied the effects of context upon information prediction. They presented letters tachistoscipically to the subjects and found that the number of letters identified correctly inereases when the stimulus sequence provides a context familiar to the observer. Context clues seemed to reduce the number of possible alternatives open to the subject and therefore reduced the amount of information each letter carried. One should be careful not to generalize from this experiemnt because Miller et al. used only six subjects.

Deese's analysis, as cited by Postman (1964), captures the essence of the above language and memory studies. He claims that recall increases with the order of approximation of the stimuli (to the English language). The increase in order influences not so much the quantity retained but the subject's ability to reconstruct the material essentially by guessing on the basis of his knowledge of the language.

Summary

The evidence from the work concerning organizational processes and memory indicates that the subject is not merely a passive recipient of stimuli but rather an active ". . . information handler applying his knowledge of the nature of the stimulus and response to reduce his memory load (Alin, p. 93)."

The subjects, it appears, used different strategies for recalling different material. Items in a series may best be recalled by utilizing a recoding method; grouping the items, assigning a new name and remembering the new name. The process is essentially Miller's information process of chunking.

Knowledge and use of an organizing system seems to facilitate the retrieval processes. Short term visual memory and its components of storage and retrieval mechanisms will be related to reading in the following section.

III. Reading and Short Term Memory

The art of reading is an active process that involves the subjects retention ability. Carroll (1972), in a study of short term visual recognition memory, hypothesized that ". . . visual memory

may be an important factor in many areas of the learning process, since for academic subjects such as reading, the child must be able to recall information that has been presented visually (p. 152)." Recognition of visual input such as words, relies on the short term memory to relay information to the permanent store and is therefore related to reading behavior.

Short term memory and its role in the reading process is beginning to draw interest from researchers. There are mainly two basic experimental designs used in studies of visual memory and reading; a recognition task and a reproduction task design. The former usually calls for a verbal response as opposed to a response requiring a degree of motor skill.

Utilizing a visual recognition design Anderson (1970) investigated the hypothesis that Visual Recognition Memory is related to paired associate (PA) learning in children who are in the early stages of learning to read and that reading achievement is related to performance on a PA task where stimuli are letter-like forms. Individually, sixty-four second grade children were first shown six letter like forms and then without interruption they were shown the same forms mixed in with various transformations of these forms. The subject's job was to identify which forms were old and which were new. The results supported Anderson's hypotheses but very interestingly a closer look at the data demonstrated that good readers were superior to poor readers in identifying old stimuli but poor readers did as well as good readers in detecting new stimuli. During the reading process it is necessary for the reader to build up recognition patterns for

familiar letters which will eventually become the basis for immediate word recognition. It seems logical to suggest that if a beginning reader does not learn to identify familiar stimuli he will remain a non-reader or at least a reluctant one.

A study outside the field of reading but related to Anderson's, is Vurpillot's (1968) experiment of scanning strategies. She presented children of various ages with a pair of drawings. They had to decide if the pair was the same or different. Vurpillot wanted to find out on what basis the children came to their decision. She found that 4 and 5 year olds made many errors but 6 to 9 year olds improved considerably. It seemed that the fewer the differences in the objects the more the errors. In other words the more the pictures resembled one another the more difficult it was for the children to make a decision. Vurpillot believes the difficulty was because the younger children did not scan enough of the stimuli or were very inefficient in their strategies; scanning randomly. The poor readers in Anderson's study may not be looking at the entire letter-like form or they may not have defined for themselves a workable criterion for 'same' and 'different'. They may make their judgments on input gained randomly rather than on a systematized scanning procedure.

Visual Sequential Memory

Attacking the problem of memory and reading achievement from a slightly different view, Guthrie and Goldberg (1972) hypothesize that central to reading is the simultaneous operation of several memory functions. Defending their definition of visual sequential memory and

its correlation to reading, Guthrie and Goldberg state that a memory for sequence is vital to word recognition in reading. In order to successfully read the word bad, each letter must be recalled in proper sequence or the word might come out as dab. The same is true for phrases or sentences. Comprehension necessitates proper lexical sequence. Guthrie and Goldberg used such tests as the Benton Visual Retention Test (BVRT), the Illinois Test of Psycholinguistic Abilities, Gray Oral Reading and Metropolitan Reading Comprehension to establish reading achievement and memory correlations. Their design included a partial correlation which removed chronological age as a variable. The results indicated the Benton Visual Retention Test had more correlation with reading then all of the other tests combined. All of the tests required visual memory but ". . . the Benton Test also requires the subject to remember both the form and the attitude (rotation) as well as the sequence of the stimuli (p. 49)." Because of the Benton Test's high correlation with reading it may be speculated that reading also requires the simultaneous functioning of memory for form, rotation and sequence.

It is yet unclear as to what exactly the relationship is between reproducing geometric designs from memory and reading achievement but research shows that a positive one does exist. This knowledge can be very beneficial in diagnosing reading difficulties.

Two other studies Froehlich (1970) and Noelker (1973) the former using white middle class children and the latter, white children having fathers with skilled or semi-skilled backgrounds, demonstrated a significant correlation between visual memory for designs having components of form, orientation and sequence and reading achievement.

Although there may be some question about the relationship that memory for designs has with the reading of letters and words, research does show a relationship and therefore it is a factor worth considering when investigating reading difficulties.

In a unique memory experiment that is directly related to the reading act, Calfee and Jameson (1971) investigated the relationships among memory load, reading speed and number of target words. They presented 24 college students with a list of either 1, 2 or 4 'target' words and asked them to count the number of times the words appeared while reading a selection for comprehension. The passages were well known works of fiction such as Of Mice and Men. After reading each page the subjects wrote down the number of times the target words appeared and answered two comprehension questions.

Calfee and Jameson found that the time needed to read the passages increased significantly with the number of different words the students had to count while reading. They suggest that ". . . memory load was a significant factor in reading speed indicating that central cognitive processes involving the storage or maintenance of readily available information plays a critical role in performance of skilled readers (p. 15)." Reading speed was affected but reading comprehension was not. They explained that a fluent reader's decoding skills are so automatic that the task of identifying and tallying target words did not interrupt the reading process. The subjects appeared to adjust their rate of reading as more words were added to the list so as not to hinder their understanding of the passage.

Three limitations should be considered before indiscriminately accepting Calfee and Jameson's results: (1) they only used 24 students; (2) they were college students who could have been extremely proficient readers, and (3) the comprehension test could have been too easy for the subjects. However the investigator must admit that it is rather exciting to think that the more proficient one becomes in reading the more time or resources the brain has for giving attention elsewhere.

The importance of memory in the reading act plus the paucity of research relating short term memory studies to reading lead Woychuk (1973) to an investigation of student's visual memory span for different materials and their relation to reading achievement. Woychuk examined memory span for designs, digits, letters and words in achieving and non-achieving readers at the grade three level. Digit, letter and word tests were constructed by Woychuk specifically for her study.

Woychuk's results were very interesting and contributed significantly to the researcher's thinking. She found that the achieving readers attained higher mean scores than the non-achievers on all of the memory tasks. Within both achievement groups, the readers found digits easier to retain than letters and words. With intelligence partialed out the differences between the two groups was maintained. Specifically between the two groups there was a highly significant difference in their ability to retain letters and words. The relationship between the Gates-MacGinitie Reading Test and the various memory task scores reached a .01 level of significance. The Letter Memory Test seemed to show the highest correlation coefficient with

reading achievement. It was interesting to note that the Digit Span Test was the only memory task that reached a level of significance for the non-achieving readers. The relationship between reading and retaining digits is questionable (Dornbus et al., 1970). It is possible that Woychuk's Digit Span Test was not sufficiently challenging for her subjects.

To determine which memory test was the best predictor of reading success, Woychuk utilized a multiple regression analysis. The Letter Memory Test was the single best predictor of reading achievement accounting for 48.75 per cent of the variance (p. 68).

Woychuk has shown the importance of visual short term memory as it relates to reading achievement, particularly memory for letters. Further research needs to be done to confirm Woychuk's findings and to include an organizational component in the memory tasks.

Summary

Recent experiments have indicated that:

(1) memory for various forms is related to reading achievement for beginning readers;

(2) speed of reading is affected by memory load but comprehension is not necessarily affected;

(3) memory tasks of digits, letters and words correlate significantly with reading achievement with letter span being the best predictor of reading achievement; and

(4) all studies reported drew their subjects from a middle class population.

IV. Visual Discrimination, Memory and Reading

During the reading process, what goes in is what will be matched and recalled. Therefore the sensory trace or contact should extract the relevant features of the stimuli to aid the retrieval and learning processes. Vernon (1958) found in her study of five, six and seven year-olds much confusion with words of similar configuration. She noted that ascending and descending letters as well as initial and final ones were observed more than others. The children in this study were definitely inferior in analyzing and differentiating small details of shapes and orientation and order of appearance.

Another advocate of distinctive feature analyzing is Gibson (1965) who believes that a first requirement in learning to read demands development of the perceptual skills. Children must be directed to identify the important distinguishing features of letters in order not to confuse them, for example, O with G and P with d. Focusing on specific characteristics of letters and this includes orientation and sequence, enables the sensory store to detect and store the most economic and useful information.

Visual discrimination may be used as a predictor of reading. Weiner, Wepman and Morency (1965) gave the Chicago Test of Visual Discrimination to 259 seven and eight year olds. Given as a matching rather than a memory test, the visual discrimination test distinguished between good and poor readers. One caution should be kept in mind regarding the experiment; the reliability of the test was not adequately checked.

Visual discrimination is a factor relating to reading achievement and thus it should be accounted for in an investigation of memory and reading achievement.

V. Socio-economic Factors and Reading Achievement

> On the career of an individual or cohort of individuals, the circumstances of the family of orientation -- its size, structure, socioeconomic status and stability -- provide a set of "initial conditions" whose effects are transmitted through subsequent stages of attainment and achievement (Hauser, p. 2).

A child's total environment influences his potential and achievement. What effect, specifically, do socio-economic factors have on academic achievement? Hauser (1971) worked with 17,000 students in the state of Tennessee. He found that family background does contribute modestly to success or failure in reading. To try and determine which aspects of the home environment are most influential in affecting a child's school performance, Fraser (1959), studied over 400 subjects age 12-1/2 to 13-1/2 years old. The home environment was assessed according to the following factors:

A. Cultural -- parents' education and reading habits

B. Material -- income, occupation of father, family size

C. Motivational -- parents' attitudes toward education

D. Emotional -- general impression of home and whether or not mother worked (p. V).

Fraser reported a highly statistically significant correlation of .490 between the education of the parents and school progress (p. 42). With intelligence partialed out the relationship between the occupation

of the child's father and progress at school reached the .001 level of significance (p. 52). The results lend credibility to the criteria on which the Blischen Occupational Scale was based, namely occupation and education.

The results of Fraser's study are extremely interesting and give rise to the question whether the relationship between parental education and occupation and achievement exists within Canadian society. To determine if the academic performance of Canadian children is influenced by socio-economic factors, Malik (1966) in connection with the Canadian Welfare Office attempted a vigorous investigation of 399 families in four Canadian cities. The families were either on public assistance or were low income families. The majority of the parents in both groups had left school before age 16 and 1/4 of the parents had no formal education at all. Many children, especially the boys, followed in the same pattern as their parents and quit school at an early age. The most important difference between the two types of families was in the amount of interest and support the control children (low income) received from their parents regarding school aspects and future possibilities. School reports were gathered for almost four years on the subjects' performance. The results indicated that the control children by far excelled in school performance as compared to the children in the experimental group in all eight of the academic subjects reported (p. 133). Again it appears that various home situations influence school performance. According to the Canadian Welfare Council ". . . the occupation of the head of the family is usually considered a key index in determining social class. Occupation and education jointly

determine the stability of one's employment and future prospects (p. 5)." It has already been noted that the most important difference in the two groups was the encouragement the children received regarding future possibilities. The more successful children were shown more interest by their parents.

Analysis of research strongly indicates that home conditions can positively or negatively affect a child's academic achievement. Socioeconomic factors such as education, income and parental interest may be variables to be investigated when studying children's cognitive potential.

Research needs to be developed in the area of visual short term memory and reading achievement. Aspects that need to be examined are the retention of stimuli and organizational factors as they relate to the reading process. Studies that examine socio-economic variables and their relationship to memory and reading achievement are also rare in the research and therefore need more investigation.

Chapter III

THE RESEARCH DESIGN

The purpose of this chapter is to give pertinent information about the research design. A brief overview of the research design is followed by a description of the sample, a review of the testing instruments and a discussion of the pilot study. Concluding the chapter is a short description of the statistical treatment of the data.

The main purpose of the study was designed to examine the retention ability of high, average and low readers of low and middle socio-economic status to determine if any differences existed in their ability to recall various stimuli and in their ability to organize units for recall.

Partially following the procedure set by Woychuk (1973) each child was individually asked to complete three memory tasks; a standardized test of letter memory, an unrelated word test developed by Woychuk and a third test of nonsense words compiled by the examiner. The tests allowed the writer to evaluate the subjects' retention capacity for different stimuli.

In order to obtain information regarding the subject's reading achievement a standardized test was administered to the pupils in one group session. To insure that all the subjects were of average ability only those students with an I.Q. of 90 and above as listed on the school's cumulative records were chosen. Information

was also gathered concerning the parents' occupation, the number of years in attendance at that particular school, and the child's sex.

I. Population and Sample

The population for the study was all grade four children in two schools; one school from the Edmonton Public School System and the other from the Edmonton Separate School System. The total sample consisted of 78 subjects from four classrooms at the grade four level.

A grade four population was chosen because the tasks involved in the study may have been too difficult for a younger group. Specifically the nonsense syllable test, which in order to complete successfully necessitates a grasp of syllabication. Secondly, the study from which the Memory for Word Test (Woychuk, 1973) was drawn involved grade three students. The investigator wanted to ascertain whether the results from grade four students differed and whether any differences could be attributed to developmental processes.

The sample was chosen on the basis of three criteria. First, the child had to have an I.Q. of 90 or higher. Secondly English had to be his first language. Finally, he must have shown on the first test, the Gates MacGinite Reading Tests, a basic understanding of the reading process which would indicate knowledge of letters and words. Anyone scoring below a grade two level was rejected because the memory tasks necessitated a firm grasp of letters and basic sight vocabulary.

Socio-economic factors were considered an important variable in this study. Hence, half of the sample was from a school in a low socio-economic area and half from a middle socio-economic area. The subjects were chosen according to the following criteria: half were to be enrolled in a Common-man or Inner-city school and half in a High status or Conventional school according to categories based on internal characteristics of the school as developed by Doll(Havighurst, 1966).

A. High-Status schools - generally found toward the edges of the city, in high income areas, and in upper-middle-class dormitory suburbs.

B. Conventional schools - generally found in areas of lower-middle class dominance and in cross-sectional employing areas or industrial suburbs. May be found in upper-middle and upper-working-class areas.

C. Common-man schools - generally found in areas of stable working-class residence, in the central city and in working-class residential suburbs.

D. Inner-city schools - generally found in slum areas of low income, high transiency, high delinquency, both Negro and white.

Doll attempted to understand the differences existing between schools by going into the school itself rather than by looking at the socio-economic situations of the school. He studied intensively 40 elementary schools.

He interviewed 185 teachers of grades four to eight and made systematic observations of each school. Doll found that teachers can identify the type of school in which they work by using the following chart (Figure 2, p.38).

The teachers in each school were given a sheet with the numbers 1 to 8. They were asked to look at each division on the checklist, i.e., Curriculum and Teaching Material (see Figure 2) and choose the category A B C or D which most appropriately described their school. The answers chosen were joint responses, that is, the teachers discussed the alternatives and decided among themselves which category best described the socio-economic status of their school. The results are given in Table 1.

At times the teachers were unable to limit themselves to one response, thus in some categories two answers were chosen. It is noted that the responses for school O are all A's or B's, four in each category in contrast to the low socio-economic school that has checked response C for each category. It appears that school O was rated as a middle socio-economic school and school * can definitely be called a school within a low socio-economic area, according to Doll's breakdown.

The second criteria for socio-economic rating was determined by the Blischen Economic Scale for Occupations. In 1958 Blischen described a system whereby occupations listed in census publications could be ranked in terms of socio-economic status: the system made use of data on education and income characteristics of incumbents

FIGURE 2

1. Curriculum and Teaching Material

A	B	C	D
Curriculum is enriched with extra work. Texts one year or more above grade level can be used.	Curriculum is used as planned. Texts at grade level can be used.	Curriculum is altered downward. Difficulty in the use of grade level texts.	Curriculum does not fit student's needs. Texts one to two years below grade level must be used in many cases.

2. Teaching Emphasis

A	B	C	D
Almost all of teacher's emphasis on academics. Students willing and able to cooperate in this regard.	Most of teachers' emphasis on academics. Some students unwilling or unable to cooperate in this regard.	Teacher's time divided between teaching academics and controlling student behavior. Some disorder in hall and around building can be controlled.	Majority of teacher's time devoted to controlling student behavior. Much disorder in class and around building which is difficult to control.

3. "Cultural Experience"

A	B	C	D
Wide and meaningful "cultural" experiences part of student's every-day life. School can enrich and support these cultural experiences.	Some exposure to "cultural" experiences. Student accepts and enjoys these "cultural experiences when such experiences are encouraged by school.	Little exposure to "cultural experiences and reluctance on the part of many students to accept, these experiences when they are encouraged by school.	Almost no exposure to "cultural" experiences. Often a struggle for school to prepare students for these experiences. Resistance on the part of students toward these experiences.

4. Respect for Teacher

A	B	C	D
Little or no disrespect from students and parents. Strong positive attitudes by almost all students and parents toward teacher.	A few instances of disrespect from students and parents. Positive attitudes by majority of students and parents toward teacher.	Wide range in attitudes of respect from students and parents. Some ambiguity in students' and parents' attitudes toward teacher.	Flippant attitudes and some disrespect toward teacher from many students and parents. Apathy on part of many students. Some damage to teacher's personal belongings.

5. Attitudes of Parents

A	B	C	D
Majority of parents most helpful and even initiate helpful programs and carry them out. Teachers may even feel some parents are too "pushy" with children and that some parents "look down on teachers."	Parents accept what the school feels is best for the children and are willing and able to follow teacher's suggestions.	Many parents want children to do well but equate being good in school with doing well in academics. Teacher accepted as authority by majority of parents.	Many parents apathetic and many unable to offer any help to students even if they want to. Some hostility toward teacher on the part of some parents.

6. Student Hostility

A	B	C	D
Few or no fights among students. Hostility is verbal. Some teasing among students.	Hostility sometimes expressed in "showing matches". Hostility is still mostly verbal.	Hostility expressed in some rough fights of wrestling-punching type. Verbal hostility may contain some profanity.	Hostility expressed in many rough fights, started easily with some being hard to stop. Verbal hostility contains some profanity.

7. Climate of School

A	B	C	D
Climate of school set by academically oriented pupils. Children with discipline problems can be easily handled within framework of the school. Discipline problems are mild.	Children with discipline problems are seldom leaders of student behavior but can exert influence in some cases. Discipline problems can be handled within the frameword of the school.	Children with discipline problems may be leaders for some students and sometimes upset academic situations. Majority of discipline problems can be handled within framework of the school; a few cannot.	Children with discipline problems are influential in setting climate of the school. Many children with discipline problems require the help of outside agencies such as police or Family Service.

8. Sources of student Values

A	B	C	D
Students receive their values through contact with stable and respected adults. Students will identify with peer group but also identify with future adult role.	Students influence by a well behaved peer group. Behavior somewhat patterned after models offered by movies or TV. Students still identify with adult role.	Students strongly influenced by peer group. Behavior and dress patterned almost entirely on models offered by movies or TV. Many have no identification with future adult role.	Students heavily influenced by an alienated peer group. Many students influenced by delinquent adolescent and adult models. Many have hostility toward wider society and little identification with future adult role.

TABLE 1

TEACHER RATINGS OF SCHOOLS BASED ON
INTERNAL CHARACTERISTICS

	A High Status	B Conventional	C Common Man	D Inner City
1.		0	*	
2.	0		*	
3.	0	*	*	
4.		0 *	*	
5.		0 *	*	
6.		0	*	*
7.	0		*	
8.	0		*	

0 = responses of teachers in middle class school

* = responses of teachers in low socio-economic school

of these occupations obtained during the 1951 census. In the revising and updating of the Blischen scale with the 1961 census data it was decided to include a procedure which assigns approximations of the Pineo-Porter prestige scale which measures what is usually meant by the social standing or prestige of an occupation, to census occupational titles. Thus the most recent Canadian occupational index derives its ratings from the combined variables of income, education and prestige. One definite drawback of this scale resides in the fact that only occupations characteristic of males in the labor force were included on the assumption that the family's social status is dependent upon the occupation of the husband rather than the wife when both are working. When possible the Blischen scale was used.

Many studies undertaken in Western Canada have used the Blischen scale as the main guide for delineating populations into social classes. Miller (1970) used the concept of socio-economic status presented by Blischen in his study of the relationship of socio-economic status to grade six childrens' reading of proverbs. He found a significant correlation between the subjects' scores on a reading test and their abstract achievement scores on the proverbs test.

Muir (1971) also used the Blischen Scale in her study designed to appraise pupil competence in comprehension of science and social studies material. She found that the factor of socio-economic status is significant to pupil achievement in comprehension tests particularly at the grade four level.

Taylor (1971) and Mosychuk (1965) found the Blischen scale a satisfactory means for defining social stratifications pertinent to their research.

It is recognized in the field of sociology that many factors such as occupation, material wealth, attitudes, and activities lend to a definition of one's socio-economic level. Barber (1957) stated that socio-economic classification should be based on: (1) how people evaluate one another, (2) how people associate with one another, and (3) the material possessions and symbolic activities people display.

Many people have argued whether class stratifications are mainly subjectively or objectively determined. Centers (1949) claims that

> ". . . social classes in their essential nature can be characterized as psychologically or subjectively based groupings defined by the allegiance of their members. Integral to their structuring are tendencies toward common conceptions by their members of the qualifications for membership in them, tendencies toward common conceptions by their members of the occupational characteristics of their membership, tendencies toward common attitudes, beliefs and behavior in economic and political matters . . . These constituent tendencies in the formation of social classes are the responses of individuals to the whole complex situation of their lives, but are determined to a very large extent by their statuses and roles in their activities of getting a living (p. 210-211)."

Many of the socio-economic classification systems rely on occupation as the main determinant. Whatever the disadvantages, the Blischen Scale does seem to be relevant and the most recent scale for establishing socio-economic boundaries.

The third and final criterion used for classifying the subjects into socio-economic levels involves transiency; the number of schools the child has been enrolled in during his school career. Younger children need a semblance of continuity during their initial schooling. Frequent school changes often cause a child to lag academically when compared to his peers who have had a stable school record. This lag may be caused in part by variations in tests, methods and approaches among the different schools. A subject was considered at a disadvantage if he had moved three times during his academic past.

The investigator discussed the general characteristics of the low socio-economic area pertinent to this study with some of the school personnel. It was generally agreed that there was a large percentage of one parent families, a high turnover rate and many parents with only a grade school education. When asked what he thought was the school's main problem concerning the children, the principal stated that the parents don't fulfill the needs of the children; not necessarily money or material things but in terms of basic physical care and attention.

In summary, the criteria for inclusion into a specific socio-economic class depended on the "within" school rating, the Blischen Scale rating and the number of the subjects' geographical moves during his school attending years. Tables 2 and 3 illustrate the stratification of students by father's occupation and years attending present school. The total for Table 2 does not

TABLE 2

STRATIFICATION OF STUDENTS
BY FATHER'S OCCUPATION

Occupational Rating	School A (Middle-high SES)	School B (Low SES)
Middle to high	33	2
Low	5	36
Total	38	38

*Using the Blischen Occupational Index Scale

TABLE 3

STRATIFICATION OF STUDENTS
BY GEOGRAPHIC MOBILITY

	Middle socio-economic School	Low socio-economic School
Years Attended Present School	Number	
3 - 5	30	19
1 - 2	8	21
Total	38	40

include two children whose father's occupations it was unable to determine.

II. Instrumentation

Most of the tests used in the study were not standardized commercial products except for the Gates-MacGinitie Reading Tests and the Detroit Tests of Learning Aptitude. This section attempts to describe these tests, to explain why they were used and how they were administered and scored.

Reading Assessment

In order to obtain an indication of the subjects' reading levels, the Gates-MacGinitie Reading Tests Survey D, form IM was given to four grade four classrooms. Survey D is intended for use in grades four through six. There are three equivalent forms to this survey each consisting of three parts: speed and accuracy, vocabulary, and comprehension. The vocabulary and the comprehension sections were both administered but because of an extremely high correlation, .95 (Buros, 1972) between the vocabulary and comprehension sections only the comprehension scores were used to ascertain reading achievement levels.

The comprehension test ". . . measures the student's ability to read complete prose passages with understanding (Gates-MacGinitie Manual, 1965, p. 1)." The test consists of 21 passages in which 52 words have been deleted. The subject's task was to choose the correct word for each blank from a choice of five words. The

passages gradually became more difficult.

Norms for the Gates-MacGinitie Reading Tests were developed from the tests taken by 40,000 students in 38 communities in the United States. The comprehension subtest has a split-half reliability of .94 and an alternate form reliability of .83 (Gates-MacGinitie, 1962, p. 8). The comprehension subtest is a timed test but the authors claim it is not a speed test and that most students will have time to try all of the questions. The investigator found this to be true. All children in both schools finished the task in the allotted time.

Millman (Buros, 1972, p. 686) criticizes the comprehension subtest stating that it measures only slightly such skills as recognizing the author's purpose, attitude and drawing inferences from context. He suggests that the instrument appears capable of measuring a large number of comprehension skills but mainly assesses vocabulary and determining meaning from context. He does believe that the Gates-MacGinitie Reading Test is an instrument that can be utilized confidently to indicate students' levels of reading achievement.

In order to establish each subject's reading achievement level the range of scores obtained from both schools combined were divided into thirds. Pupils with scores falling in the top third were designated as high reading achievers; those in the middle third, average readers, and those falling in the bottom third, low reading achievers. The distribution was as follows: high reading

achievers - 19, middle - 33, and low - 26.

Visual Discrimination

The Huelsman Word Discrimination Test, form B, Alta was modified for use in this study. The original test had 96 items from which the researcher extrapolated every third item for the total of thirty test items. The test was timed for a duration of two minutes. The majority of the subjects finished at least twenty items. This test was included in order to determine if visual discrimination might in any way affect a child's reading achievement. This test requires the child to visually distinguish among four examples similar in letter shape to the test stimuli. A modified version used in the study is found in the appendix. No reliability has been published for this test.

Letter Memory Test

The Letter Memory Test is the name given to the Visual Attention Span for Letters, Test 16, adapted from the Detroit Tests of Learning Aptitude. The test consists of six sets of letters with four trials in each set. The first set is of two letters for each trial and increases by one until the sixth and final set of seven letters.

The prepared cards of the test were shown to the subjects one second for each letter on the card. The letters are printed in heavy bold type and are evenly spaced. The test was terminated

after the subject failed to recall correctly four successive sets.

The Visual Attention Span for Letters Test is one of nineteen subtests that has been standardized using the scores of 150 pupils at every age level. Test reliability was first established on 48 cases with a correlation of .959 (Detroit Tests of Learning Aptitutde, Examiner's Handbook, 1967, p. 130). A correlation of .675 was later found for a group of 792 pupils ranging in age from seven to twelve years.

Non Standardized Tests

Word Memory Test

There is no meaning inherent in the Letter Memory Test except for whatever meaning individual letters denote. The Word Memory Test has been included in the study as an assessment of retention ability but with the added element of meaning or associational possibilities inherent in each word. Possible associational tendencies might have been an aid to recall thus making items on this test appear easier to retain. The meaning factor was not at its ultimate as found in sentences but it would be present to some degree.

In order to have some basis for comparison between studies, the Word Memory Test developed by Woychuk (1973) was used in this study. The test consisted of sixteen spans of unrelated words increasing from two to nine words. Duration of exposure was one second per word. Each word was typed using a primer typewriter on

white cards and spaced evenly so the subject would not be covertly encouraged to associate one word with another. The test was stopped when the pupil missed four consecutive spans. The subject's score was the number of the last span correct immediately preceding the four errors.

Woychuk selected the one syllable words for the test on the basis of frequency and familiarity. To achieve the two criteria the following guidelines were observed (Woychuk, 1973, p. 42-43).

(1) Each word was selected from the Dolch Basic Sight Vocabulary (Dolch, 1960, p. 256) and rank ordered according to the Kucera-Francis list (Otto and Chester 1972, p. 437-444) as one of the 200 most frequent words,

(2) Each word is a 'service' word at or below second grade level. Dolch (1960) defines basic service words as general words; not nouns but the simplest verbs, adverbs, pronouns, adjectives, prepositions, and conjunctions.

Nonsense Syllable Test

The items in this test are real words taken from Websters Dictionary (1957) but are nonsense to the subjects in the sense that the words are totally without meaning and foreign to their vocabularies.

Numerous researchers have used nonsense syllables (CVC) in

experiments on memory. Many years ago Davis (1930) suggested that words may have some advantages over nonsense syllables. She believed that the consonant-vowel-consonant pattern often was difficult to learn and seemed quite uninteresting to many subjects.

Cieutat (1963) randomly selected 446 monosyllables, bi-syllables and trisyllables and rated them on a meaningfulness scale composed of association, familiarity and pronunciability elements. Subjects numbering 126 rated each word on a seven point scale from which three indices of association were found. Cieutat reported that all three indices have uncorrected reliabilities in the range .95 to .98.

The investigator chose words between .34 to .60 on Cieutat's scale that ranges from .31 to 1.00. The more associations with a word the closer to 1.00 would be the rating. No words were chosen for the study that contained double letters such as the two t's in butter, or two vowels together.

Each word was typed on a card in primer size. The subject was shown one card at a time then asked to print the letters he saw. After the pupil finished printing a word he was asked to pronounce it. By asking each subject to say the words, the researcher hoped to determine the child's method of remembering, i.e., by individual letters or by grouping the word into syllables. One point was given for each correct syllable with 50 of the maximum number possible.

The Nonsense Syllable Test was included in the study as an attempt to determine what part organization played in the retention

processes. The Gates-MacGinitie Reading Tests and the Huelsman Word Discrimination Test, adapted form, were administered in group situations in contrast to the remaining three memory tests which were individually given. All tests were hand scored by the investigator.

Reliability

To achieve a reliability coefficient for the Huelsman Word Discrimination Test, the Word Memory Test and the Nonsense Syllable Test, a split half method was used. This method is appropriate if the testing instruments can be divided into halves yielding two scores. Reliability coefficients are a measure of the internal consistency of the test material. If the various items on the test appear to measure the same attributes then the correlation will be high. If the various items on the test measure different attributes or if error is present, the intercorrelations will be low. (Table 4).

Woychuk (1973) employing a test-retest method of measuring reliability, found a reliability coefficient of .92 for the Word Memory Test (p. 43).

TABLE 4

RELIABILITY COEFFICIENTS FOR MEMORY AND VISUAL DISCRIMINATION TESTS

Tests	Nonsense Syllable	Word	Letter Visual Discrimination
Reliability Coefficients	.92	.50	.68[1]	.81

[1]Detroit Test of Learning Aptitude, Examiner's Handbook, 1967, p. 130.

III. Pilot Study

A pilot study was conducted in February, 1974 using fifteen randomly selected grade four children from two classrooms. The children were identified as high, middle or low reading achievers according to the evaluation of the teachers and assistant principal. The purposes of the pilot study were:

(1) to establish the difficulty of the nonsense syllable items;

(2) to determine the scoring method of the nonsense syllable test;

(3) to determine if there were any differences between scores of the high, average or low readers on the memory tests;

(4) to practice administering the memory tests; and

(5) to see what type of information was available on the cumulative records for the purpose of identifying children of low socio-economic status.

Based on observations during the pilot study the following changes were made.

(1) Some of the nonsense items were changed because it was thought that they were too easy for fourth graders. Also two bisyllable words replaced two monosyllable words.

(2) Giving one point for each syllable correct rather than each word was the scoring procedure adopted.

(3) Differences were found between reading achievers at the various levels.

(4) The instructions given to the students had to be modified. The researcher found that the instructions were somewhat confusing and too detailed. The directions were changed to succinct direct statements.

(5) The information reported on the cumulative cards was found to be satisfactory for categorizing children into different social classes.

IV. Collection of Data

The main study was carried out during the last three weeks in March and the first week in April. All tests were administered and scored by the researcher. The Gates-MacGinitie Reading Tests and the Huelsman Word Discrimination Test were administered to each grade four class in a group situation within their respective classrooms. The memory tests were given individually in a quiet out-of-the-way room.

The order of tests given was: Word Memory Test first; followed by the Nonsense Syllable Test and the Letter Memory Test. The total testing time was twelve to fifteen minutes per student.

V. Treatment of the Data

Examination of the hypotheses was undertaken at the University of Alberta Division of Educational Research Services via the following statistical procedures.

Computation of Correlations (DEST 02)

Using this program correlation matrices were computed for the reading, memory and visual discrimination variables for the high average and low reading groups and for the entire sample.

Analysis of Variance (ANOV 15)

This program was used to determine the means and their significance for each achieving group on the reading and memory tests.

Analysis of Variance (ANOV 25)

A one-way analysis of variance was used to determine whether any interaction effect occurred between socio-economic variables and reading, memory and visual discrimination tasks. This program also computed the means for each variable and their significance for each achieving group within each school.

Uncorrelated t-Tests (ANOV 10)

t-tests were used to assess the significant differences of the mean raw scores between the two schools on the reading, memory and visual discrimination tests.

Stepwise Discriminant Function (MULR06)

This program involves a multiple regression analysis that identified the contribution of the memory and visual discrimination variables as possible predictors of reading success.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

In this chapter the data obtained will be examined according to the following divisions:

1) Performance of groups on the Gates-MacGinitie Reading Test;

2) Relationship between high, average and low readers on the Nonsense, Word and Letter Memory tasks;

3) Relationship between memory tasks and reading scores;

4) Relationship between high, average and low readers on a Visual Discrimination task; and

5) Additional findings.

Differences were considered statistically significant if they reached the .05 level.

I. Performance on Reading Achievement Test

Information regarding the subject's reading abilities was obtained by analyzing the scores from the Gates-MacGinitie Reading Test, Survey D, Form IM. Only the comprehension score was used as an indicator of reading competence. Three reading groups were formed on the basis of the Gates-MacGinitie reading scores. The top third of the scores formed the high achieving group; the middle third the average

achievers; and the bottom third of the reading scores formed the low achieving group. The range of scores was from 12 to 49 correct out of a possible 52. The mean scores and variances of the reading test for the three groups are reported in Table A, p. 59.

A Scheffe multiple comparison of means test indicated a significant difference among the means of the Gates MacGinite Test of all achievement groups at the .01 level (Table B, p. 59).

To obtain some indication of the performance of each of the reading groups on the standardized reading tests in comparison to the norming sample on which the test was standardized, each mean score was converted to a grade score equivalent. Grade score equivalents for each of the three fourth-grade reading groups was 7.2, 5.0, and 3.8 respectively beginning with the highest achievers. (The testing took place during the subjects' seventh month of the fourth grade.)

An analysis of variance was used to determine the extent of reading score differences on the Gates-MacGinitie Test between the middle socio-economic school and the low socio-economic one. Two main effects were analyzed: 1) a comparison effect which determined the significance of the combined reading score differences between the two schools (effect A); and 2) a comparison effect which indicated the differences between each achievement group for the sample as a whole (effect B).

The main effects will be discussed separately in the following paragraphs in relation to the results of the analysis of variance on

TABLE A

MEANS AND VARIANCES ON GATES-MACGINITIE READING TEST FOR HIGH, AVERAGE AND LOW ACHIEVERS

	Number	Mean Raw Score	Variance
Groups			
High Achievers	19	41.68	13.22
Average Achievers	33	31.69	5.34
Low Achievers	26	20.92	24.39

TABLE B

SCHEFFE MULTIPLE COMPARISON OF MEANS AMONG ACHIEVEMENT GROUPS ON THE GATES-MACGINITIE READING TEST

Between Groups	F-Ratio	Probability Level
High - Average	46.75	>.01
High - Low	15.48	>.01
Average - Low	50.68	> .01

the Gates-MacGinitie Reading Test.

Effect A - The analysis of the reading scores revealed that the difference between schools of the combined mean scores for the reading test reached a level of significance at the .05 level, in favor of the middle socio-economic school (Table C, p. 62). The mean scores were plotted to get a better idea of the distribution of the scores for each school (Figure 3, p. 61).

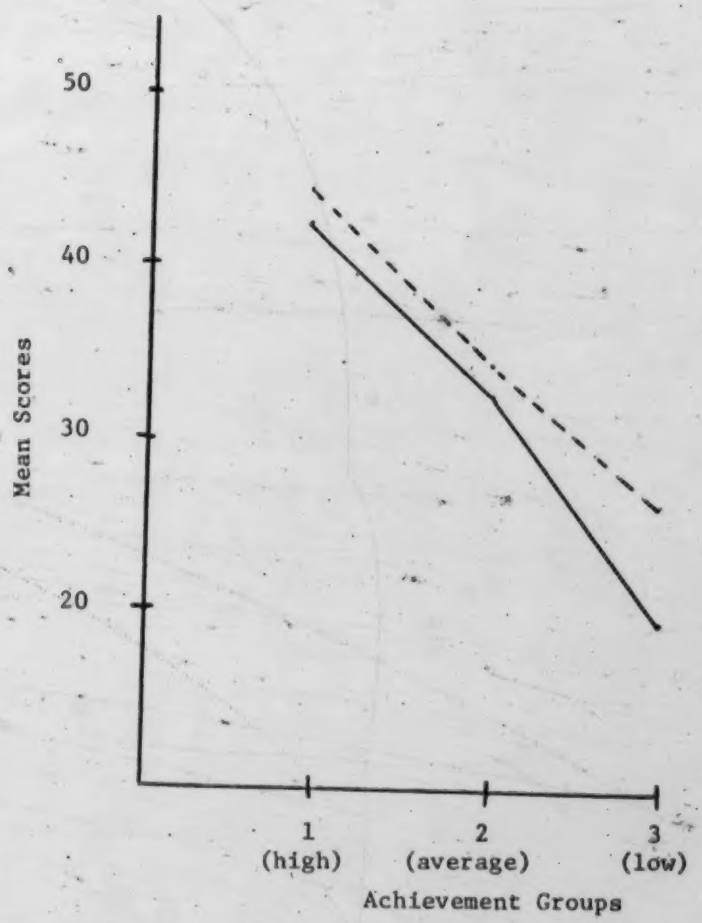
An attempt to identify the groups that contributed to the significance of effect A was undertaken by applying uncorrelated t-tests to the achievement groups. Each achievement group was compared to its counterpart in the second school; for example, the mean score for the high achievers from the middle socio-economic school was compared to the mean score for the high achievers from the low socio-economic school. The results for each achievement group on the Gates-MacGinitie Reading Test are given in Table D, p. 62. The means for the low achievers were the only ones between which there was a significant difference at the .01 level.

It should be noted that only six children in the middle socio-economic school qualified for the low achievement group, as compared to twenty in the low socio-economic school.

Effect B - (the difference between achievement groups when the scores for both schools were combined), showed a level of significance beyond the .01 level for each group as reported in Table B.

FIGURE 3

MEAN RAW SCORES FOR SCHOOLS
ON GATES-MACGINITIE READING TEST



Middle Socioeconomic School - - - -
Low Socioeconomic School ———

TABLE C

ANALYSIS OF VARIANCE OF COMBINED GROUP SCORES BETWEEN SCHOOLS ON GATES-MACGINITIE READING TEST

	Sum of Squares	D.F.	Mean Squares	F Ratio	Probability
Effect A	77.95	1	77.95	6.13	.015

TABLE D

T TEST DIFFERENCES AMONG MEANS OF THE ACHIEVEMENT GROUPS ON THE GATES-MACGINITIE READING TEST FOR MIDDLE AND LOW SOCIO-ECONOMIC SCHOOLS

Groups		High Socio-economic School	Low Socio-economic School	D.F.	t-Value	P-Two-Tail
High	Number	12	7	17	.615	.546
	Mean	42.08	41.00			
Average	Number	20	13	31	.932	.358
	Mean	32.00	31.23			
Low	Number	6	20	24	2.680	.013
	Mean	25.17	19.65			

II. Relationship Between High, Average and Low Readers on Memory Tasks

To study the visual retention capacity of readers for varying stimuli, the mean scores of the three memory tasks were subjected to an analysis of variance technique (Table E, p. 64). Each test was analyzed separately according to mean differences for the combined sample and for each school. The tests were examined in the following order: Nonsense Word, Word Memory and Letter Memory.

Nonsense Word Test.--The results reported in Table E show that the high achievers attained a higher mean score than the average achievers and the average achievers reached a higher mean score than the low achievers. A Scheffe multiple comparison test indicated that all mean comparisons reached a significance level of .01 (Table F, p. 65).

In order to determine differences between schools on the Nonsense Word Test an analysis of variance was employed to examine the two main effects mentioned previously. No significant difference was found for effect A, the comparison effect that determines the difference of the combined scores between schools (Table G, p. 65).

Effect B (the between achievement group comparison of the combined scores from both schools) reached a level of significance beyond the .01 level indicating a significant difference between each achievement group when the scores from both schools were combined (Table F, p. 65).

Figure 4. p. 66 graphically represents mean raw scores according to achievement groups and schools on the Nonsense Word Test.

TABLE E

MEANS AND STANDARD DEVIATIONS OF MEMORY TESTS FOR HIGH, AVERAGE AND LOW ACHIEVING READERS FROM BOTH SCHOOLS

	Memory Tests		
	Nonsense Syllable Maximum Score - 50	Word Memory Maximum Score - 16	Letter Memory Maximum Age - 15.9
(1) High Achievers	$\bar{X}$ 41.74 S.D. 5.90 N = 19	$\bar{X}$ 7.47 S.D. 1.90 N = 19	$\bar{X}$ 12.3 S.D. 1.91 N = 19
(2) Average Achievers	$\bar{X}$ 34.08 S.D. 7.02 N = 33	$\bar{X}$ 6.30 S.D. 1.96 N = 33	$\bar{X}$ 11.11 S.D. 1.84 N = 33
(3) Low Achievers	$\bar{X}$ 24.10 S.D. 7.76 N = 26	$\bar{X}$ 4.30 S.D. .73 N = 26	$\bar{X}$ 10.25 S.D. 1.28 N = 26

TABLE F

SCHEFFE MULTIPLE COMPARISON OF MEANS
AMONG ACHIEVEMENT GROUPS ON
THE NONSENSE WORD TEST

Between Achievement Groups	F-Ratio	Probability
High - Average	8.76	> .01
High - Low	23.01	> .01
Average - Low	5.97	.003

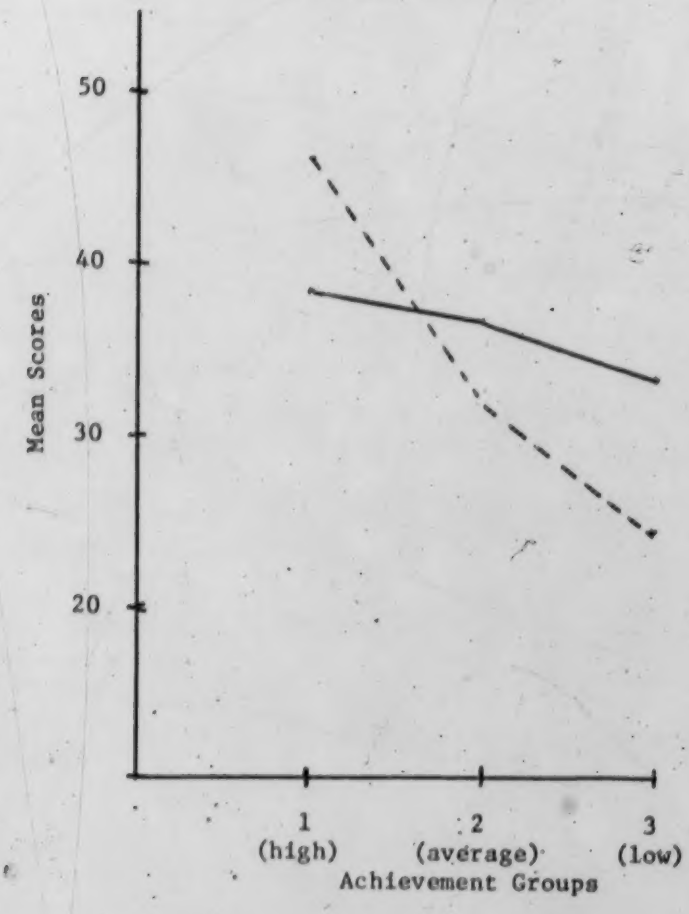
TABLE G

ANALYSIS OF VARIANCE OF COMBINED
GROUP SCORES BETWEEN SCHOOLS
ON NONSENSE WORD TEST

	D.F.	Mean Squares	F- Ratio	Probability
Effect A	1	63.87	1.42	.235

FIGURE 4

MEAN RAW SCORES FOR SCHOOLS
ON NONSENSE WORD TEST



Middle Socio-economic School ————————

Low Socio-economic School - - - - - - -

A surprising phenomenon occurred between the two high achievement groups on the Nonsense Word Test. The children from the middle socio-economic school had consistently performed better than the children from the low socio-economic school. This pattern was not completely upheld on the Nonsense Word Test. The mean raw score for the low socio-economic high achievement group was 45.29 in comparison to 39.67 for the high achievers from the middle socio-economic school. This irregularity from the pattern established by the other tests occurred only in the high achievement groups. The average and low achievers from the middle socio-economic school attained higher mean scores than the average and low achievers from the low socio-economic school respectively.

The phenomenon described above is statistically referred to as an interaction effect. The statistical analysis indicated that some combination of school and achievement level was operating that influenced the results in favor of the low socio-economic high achievement group. What it may have been cannot be determined from the data.

The interaction effect uncovered by an analysis of variance program reached the .01 level of significance (Table H, p. 68).

Effect B was shown to be significant for the Nonsense Word Test (refer to Table F, p. 65). T-tests were used to determine if differences still existed between achievement groups when each group from one school was compared to the same group from the second school. For example, differences between the two groups of high achievers, average achievers and low achievers were compared to determine their significance. It was shown that the difference between the two high groups and the difference

TABLE H

ANALYSIS OF VARIANCE OF COMBINED GROUP SCORES BETWEEN SCHOOLS NONSENSE WORD TEST

	S.S.	D.F.	Mean Squares	F-Ratio	Probability
Interaction effect	419.68	2	209.84	4.69	.012

TABLE I

T-TEST DIFFERENCES BETWEEN MEANS OF THE ACHIEVEMENT GROUPS ON THE NONSENSE WORD TEST FOR THE LOW AND MIDDLE SOCIO-ECONOMIC SCHOOLS

Groups	Middle Socio-economic School	Low Socio-economic School	D.F.	t-Values	P-Two Tail
High	Number 12	7	17	.020	.041
	Mean 38.67	45.29			
Average	Number 20	13	31	2.310	.027
	Mean 36.70	31.62			
Low	Number 6	20	24	1.756	.091
	Mean 30.67	24.10			

between the two average groups reached a .01 level of significance. Significant differences were not found between the two low groups (Table I, p. 68).

Word Memory Test.--The Word Memory Test was the second memory test used to examine grade four children's short term retention ability. An analysis of variance determined the difference in means among the high, average and low groups for both schools combined (Table J, p. 70).

The high achievers received a higher mean score than the average achievers and the average achievers scored higher than the low achievers. Significant differences were found between the high achievers and average achievers and also between the high achievers and low achievers, but not between the average achievers and low achievers (Table K, p. 70).

Socio-economic factors were also considered in relation to the Word Memory Test and reading achievement. Effect A reached a significance beyond the .01 level (Table L, p. 71). The results indicated that there was a difference between schools when the achievement groups were combined for each school and then compared.

To gain more information about effect A, t-tests were used to determine which achievement group was contributing to its significance. High, average and low achievers from the middle socio-economic school were compared to the high, average and low achievers from the low socio-economic schools. It was found that the mean differences between each achievement group were significant at or beyond the .01 level. The results are given in Table M, p. 71.

TABLE J

MEANS AND VARIANCES ON WORD MEMORY TEST
FOR HIGH, AVERAGE AND LOW ACHIEVERS
FOR ENTIRE SAMPLE

	Number	Mean Raw Score	Variance
Groups			
High Achievers	19	7.47	3.59
Average Achievers	33	6.24	3.87
Low Achievers	26	4.84	2.29

TABLE K

SCHEFFE MULTIPLE COMPARISON OF MEANS AMONG
ACHIEVEMENT GROUPS ON THE
WORD MEMORY TEST

Between Groups	F-Ratio	Probability Level
High - Average	4.66	.012
High - Low	7.04	.001
Average - Low	.626	.537

TABLE L

ANALYSIS OF VARIANCE OF COMBINED GROUP SCORES BETWEEN SCHOOLS ON THE WORD MEMORY TEST

Score	D.F.	Mean Squares	F-Ratio	Probability
Effect A	1	116.49	66.47	>.01

TABLE M

T-TEST DIFFERENCES BETWEEN MEANS OF THE ACHIEVEMENT GROUPS ON THE WORD MEMORY TEST FOR MIDDLE AND LOW SOCIO-ECONOMIC SCHOOLS

Groups	Middle Socio-economic School	Low Socio-economic School	D.F.	t-values	P-Two Tail
High	Number 12	7	17	3.710	.001
	Mean 8.42	5.86			
Average	Number 20	13	31	4.694	>.01
	Mean 7.25	4.69			
Low	Number 6	20	24	6.40	>.01
	Mean 7.00	4.20			

Letter Memory Test.--Memory for letters was the third variable analyzed in respect to short term visual retention ability. Means and variances are reported in Table N, p. 73 for the entire combined sample on the Letter Memory Test.

Only differences between the high and low achievers reached a level of significance (Table O, p. 73).

Between-school differences on the memory for letters test were not significant for effect A (Table P, p. 74).

Effect B reached significance at the .01 level (Table O, p. 73). This effect indicates levels of differences between achievement groups when the mean scores for the entire sample are combined. The significance of effect B may be partly accounted for by the significant difference between the high and low achievement group previously reported in Table O.

T-tests were used to determine significant differences between schools for each achivement group on the Letter Memory Test. Because effect A was not significant it was not expected that the t-tests would reveal any significant differences, which was confirmed (Table Q, p. 74).

The high achievers from the low socio-economic school attained a slightly higher mean than the middle socio-economic high achievers on the Letter Memory Test--the same phenomenon that occurred on the Nonsense Word Test. (However on the Letter Memory Test the mean difference between the high achievers from the two schools was not significant.)

TABLE N

MEANS AND VARIANCES ON LETTER MEMORY TEST
FOR HIGH, AVERAGE AND LOW ACHIEVERS

Groups	Number	Mean Raw Score	Variance
High Achievers	19	12.30	3.66
Average Achievers	33	11.24	3.56
Low Achievers	26	10.27	1.66

TABLE O

SCHEFFE MULTIPLE COMPARISON OF MEANS BETWEEN
ACHIEVEMENT GROUPS FOR ENTIRE SAMPLE ON
LETTER MEMORY TEST

Groups	F-Ratio	Probability
High - Average	2.25	.112
High - Low	6.83	.001
Average - Low	2.04	.136

TABLE P

ANALYSIS OF VARIANCE OF COMBINED GROUP SCORES BETWEEN SCHOOLS ON THE LETTER MEMORY TEST

Source	D.F.	Mean Squares	F-Ratio	Probability
Effect A	1	56.74	.001894	.9654

TABLE Q

T-TEST DIFFERENCES AMONG MEANS OF THE ACHIEVEMENT GROUPS ON THE LETTER MEMORY TEST FOR BOTH SCHOOLS

Groups		Middle Socio-economic School	Low Socio-economic School	D.F.	t-values	P-Two Tail
High	Number	12	7	17	.968	.346
	Mean	11.97	12.86			
Average	Number	20	13	31	.645	.523
	Mean	11.41	10.98			
Low	Number	6	20	24	.049	.961
	Mean	10.30	10.27			

III. Relationship Between Memory Tests and Reading Scores

The relationship between the combined scores for both schools on the Gates-MacGinitie Reading Test and the nonsense word and letter memory tests was analyzed by means of the Pearson Product Moment correlation technique (Table R, p. 76).

The analysis indicated that all the memory tests reached a level of significance in their correlations with the reading scores for the entire sample of grade fours. The Nonsense Word Test correlated the highest with the reading test followed by the Word and Letter Memory tests.

IV. Relationship Between Reading Groups And Visual Discrimination

Gibson (1965), Vernon (1958) and Anderson (1970) have suggested that the ability to discriminate differences between letters presented visually is basic to reading success. An analysis of variance program was used to determine whether children who were experiencing difficulty with reading, according to the Gates-MacGinitie Test, were also having difficulty in visual discrmination. Table S , p. 76, illustrates the mean raw scores for the visual discrimination test. The test consists of items extrapolated from the Huelsman Visual Discrimination Test as noted in Chapter 3.

Significant differences were found between each achievement group. The results given in Table T, p.76 reach the .01 level of significance. A Scheffé multiple comparison of means analysis was used to determine

TABLE R

CORRELATIONS* BETWEEN MEMORY TESTS AND READING SCORES

	Memory Tests		
Reading Test	Nonsense	Word	Letter
Gates-MacGinite	.67	.52	.46

*All correlations significant beyond .05 level

TABLE S

MEANS AND VARIANCES FOR VISUAL DISCRIMINATION SCORES ACCORDING TO READING GROUPS

	High Achievers		Average Achievers		Low Achievers	
	Mean	Variance	Mean	Variance	Mean	Variance
Visual Discrimination Test	24.31	8.00	21.02	8.92	18.10	6.20

TABLE T

SCHEFFE MULTIPLE COMPARISON OF MEANS BETWEEN ACHIEVEMENT GROUPS FOR ENTIRE SAMPLE ON VISUAL DISCRIMINATION TEST

Groups	F-Ratio	Probability
High - Average	6.35	.002
High - Low	24.03	.000
Average - Low	8.91	.000

the extent of mean raw score differences.

Effect A was not significant indicating no difference on the combined scores between schools on the Visual Discrimination Test (Table U, p. 78). The socio-economic status of the school does not appear to affect the significant differences among the achievement groups.

Significant differences between each achievement group's combined scores from both schools (effect B) were reported in Table T, p. 76. The results suggest that children who are poor readers were unable to pick out the distinguishing features of the words and thus did not do well on the visual discrimination test.

To determine the extent of the relationship between the visual discrimination test, reading test and the memory tests, a correlation technique was used. Each of the above mentioned variables correlated very significantly with the visual discrimination test as reported in Table V, p. 78.

V. Additional Findings

A stepwise linear discriminant function analysis was used to identify which memory tasks best predicted reading achievement (Table W, p. 79). The results of this analysis indicated that the Nonsense Syllable Test was the best predictor of reading achievement. The Nonsense Test accounted for 45.37 per cent of the variance and reached a level of significance beyond the .01 level. The next best

TABLE U

ANALYSIS OF VARIANCE OF COMBINED GROUP SCORES BETWEEN SCHOOLS ON THE VISUAL DISCRIMINATION TEST

Source	D.F.	Mean Squares	F-Ratio	Probability
Effect A	1	3.76	.510	.476

TABLE V

CORRELATION* BETWEEN VISUAL DISCRIMINATION, READING AND MEMORY TESTS

	Gates-MacGinitie Reading Test	Nonsense Memory Test	Word Memory Test	Letter Memory Test
Visual Discrimination	.63	.56	.38	.36

*All correlations significant at the .01 level

TABLE W

STEPWISE REGRESSION ANALYSIS OF MEMORY AND VISUAL DISCRIMINATION VARIABLES ON READING ACHIEVEMENT

	Variable Entering	F-Value	Probability Level	Accumulative Variance
Step 1	Nonsense Syllables	63.124	>.01	45.372
Step 2	Visual Discrim.	45.45	>.01	54.794
Step 3	Word Memory	33.02	.043	57.241

predictor was the Visual Discrimination Test which accounted for an additional nine percent of the variance. The Word Memory Test accounted for three percent more. The Letter Memory Test did not significantly contribute to the total variance.

VI. Summary

The major findings apparent from the analyses of the data are summarized below:

1) Results obtained on all the memory tasks indicated that high reading achievers were better able to retain visual stimuli than average or low achievers.

2. The average readers were better able to retain visual stimuli than the low achievers.

3. High, average and low achievers from the middle socio-economic school attained higher mean scores on the Gates-MacGinitie Test than did the readers of a low socio-economic status. Only the difference between means of the low achievers reached an appropriate level of significance.

4) Low socio-economic high achievers scored better on the Nonsense Word Test and Letter Memory Test than middle socio-economic high achievers, but only the difference on the Nonsense Word Test was significant.

5) Middle socio-economic, average and low readers attained higher means on all the memory tasks than the same two groups from low socio-economic schools.

6) The differences between the two high achievement groups and between the two average achievement groups from school 1 and school 2 on the Nonsense Word Test was significant.

7) The difference between schools for each achievement group on the Word Memory Test reached the .01 level of significance.

8) The ability to retain nonsense words, unrelated words (words that do not form a sentence) and letters all were significantly related to reading scores.

9) Visual discrimination scores for the entire sample correlated significantly with reading achievement and each memory test.

10) The high achievers on the Visual Discrimination Test attained a higher mean than the average or low achievers and the average group scored a higher mean than the lower group.

11) The Nonsense Word Test, as an indicator of immediate retention ability, was the best predictor of reading success for this sample of fourth grade students.

Chapter V

SUMMARY, CONCLUSIONS, SUGGESTIONS FOR FURTHER RESEARCH

The process of reading is a very complex and subtle one that in part depends on retention ability. Because the role of short term visual memory in the reading process has been the subject of so little investigation, the purpose of this study was to examine aspects of visual memory and their relationship to reading achievement.

This chapter presents a brief summary of the study, its findings and its implications, followed by suggestions for further research.

I. Summary

The study used three memory tests in the attempt to investigate the influence of short term visual memory on reading ability at two socioeconomic levels.

A total of seventy-eight fourth grade children from middle (N=38) and low (N=40) socio-economic schools were involved in the study. Each subject was tested individually on the memory tasks and in group situations on the reading and visual discrimination tests. Two of the tests, Letter and Word Memory were concerned with memory span per se, while the third, Nonsense Word Test dealt with the organizational aspect of memory.

The data were processed using such statistical techniques as correlation matrices, analyses of variance, and stepwise discriminant

functions. The findings of the analyses are reported in the following section.

II. Findings and Conclusions

The data are discussed under the respective null hypotheses. Their rejection or acceptance is reported, along with any additional pertinent findings.

Null Hypothesis One

When the obtained means are compared using an Analysis of Variance procedure, there is no significant difference between the scores obtained by high, average and low reading achievers on these tests:

a) Nonsense Word Test;

b) Word Memory Test; and

c) Letter Memory Test.

a) Analyses of the data revealed that a significant difference ($p > .01$) existed in mean raw scores between each of the reading achievement groups on the Nonsense Word Test. Hypothesis 1a was therefore rejected.

b) Null Hypothesis 1b was rejected for comparisons between the high and average reading achievement groups and between the high and low groups at the .01 level on the Word Memory Test, but there was no significant difference between the average and low reading achievement groups.

c) Null Hypothesis 1c was rejected for comparisons between the high and low reading achievement groups at the .01 level, but not for the other two groups on the Letter Memory Test.

Conclusion

The above results do indicate that reading proficiently and retention of visually presented stimuli are related. Woychuk (1973) also found significant differences between achieving and non-achieving readers on letter and word memory tests. The differences that are consistently significant appear between the high and low achievers. The Nonsense Word Test and the Word Memory Test were the only measures that showed a significant difference between the high and average groups. The only memory test that distinguished between the average and low groups was the Nonsense Word Test. This test also correlated(.67) with reading scores and proved to be the best predictor of reading success of fourth graders. Thus it might be concluded that the Nonsense Memory Test is a better gauge of reading achievement than the other memory tests.

The Nonsense Memory Test yielded a different type of information in regards to reading achievement than the Word and Letter Memory tests. The Word and Letter tests give information pertinent to the span or capacity of immediate memory for visually presented materials. Although the Nonsense Word Test also gives information about memory span, in addition it helps to determine what form the information is stored in. It is able to determine whether proficient readers organize the syllables into a word, thereby using a chunking procedure to recall the word or whether a letter-by-letter method of storage was used. One possible way of learning about the abstract process of memory as it is used in the act of reading, is to investigate the methods of coding visual information that children use. One viable method of coding relies on regrouping

information into a larger bit, such as letters into syllables, enabling words to be retained in the memory and retrieved at will. Another technique used to find out how information is stored called for the children to pronounce some of the nonsense words after printing them. If the children made attempts to pronounce the unfamiliar words letter-by-letter it is possible that they attempted to store and recall them letter-by-letter. If the subject analyzed and pronounced the words one syllable at a time, he may have used this same method to store the unfamiliar word. Thus when the subject had to write the stimulus word from memory he retrieved syllables and not individual letters. It was noted that the children who used the letter by letter method of analysis scored very low on the test. If, for example, the child was trying to remember the word avantlay and used a letter by letter method he would have had to retain 8 bits of information rather than 3 bits if he had stored the word by syllables. The immediate memory was probably not able to retain 8 bits and therefore children who did not organize incoming data efficiently scored low on the Nonsense Word Test.

Null Hypothesis Two

There is no significant difference as measured by the Analysis of Variance procedure between the middle (school 1) and low (school 2) socioeconomic schools on mean scores obtained from these tests:

a) Gates-MacGinitie Reading Test;
b) Nonsense Word Test;
c) Word Memory Test; and
d) Letter Memory Test.

a) When the scores on the Gates-MacGinitie Test from all groups in school 1 were combined and compared to the combined scores from

school 2, analysis of variance indicated a significant difference in achievement in favor of the higher SES school, at the .05 level. Contributing to this result was the significant difference between the low groups when the low achievement group from school 1 was compared to the low group from school 2. Hypothesis 2a was therefore rejected.

b) Although no significant difference was found between schools when the achievement group scores were combined and compared on the Nonsense Word Test, there was a significant interaction(.01) when the high and average ability groups from school 1 were compared to school 2's groups. The effect showed the high achievers from school 2 (low socio-economic status) attaining a higher mean score on this test than the high achievers from school 1. This was unusual and suggests that the particular combination of ability group and school interacted to produce the above stated results.

c) An analysis of variance technique indicated highly significant (beyond the .01 level) mean score differences between schools on the Word Memory Test when the achievement scores were combined from all groups. The analysis also indicated significant ($p > .01$) mean score differences between schools for each achievement group favoring the middle socio-economic school. Hypothesis 2c was therefore rejected.

d) No significant mean score differences were found between schools for the Letter Memory Test (nor were they found when the groups were combined or analyzed separately.) Hypothesis 2d was therefore accepted.

Conclusion

The mean score comparison on the Gates-MacGinitie Reading Test

and the Word Memory Test indicated significant differences between the middle and low socio-economic schools. No significant differences were found between schools on the combined scores for the Letter Memory Test or the Nonsense Word Test.

The Word Memory Test and the Letter Memory Test produced opposing results, (as reported above under Hypothesis 2c and 2d), when the individual achievement between school comparison was analysed. Very few children had difficulty retaining letters. Remembering words, however, appeared to be a more difficult task, especially for the poorer readers. One possible explanation for the differences in scores between the Word and Letter Memory Tests, may be attributed to hierarchical steps that many children are put through in the early stages of learning to read. Usually the letters of the alphabet are taught as the basis of reading and the children are required to memorize them before putting them together to form words. Words are not usually memorized in isolation but are learned in some contextual situation which enhances meaning while not affecting their physical makeup. Thus seeing and remembering a span of unrelated letters may have been a more familiar task than being asked to recall a span of unrelated words. Learning the alphabet by simple rote memory may be such a generalized fundamental step in school reading lessons that by fourth grade even if the child is experiencing reading difficulties he shows little problem remembering some letters, regardless of what the social-economic status of the school he attended was. Ease of retaining a span of words may be a mature ability requiring immediate recognition and matching to the long term memory and reading speed; skills

found commonly in most fluent readers.

Forgetting words presented in a list may also be explained in terms of retrieval strategies. Atkinson and Schiffrin (1971) present evidence suggesting that ". . . forgetting results from the fact that the temporal-contextual probe cues used to assess any given list tend to elicit a larger search set for longer lists, thereby producing less efficient retrieval (p. 90)." In an experiment designed to distinguish between retrieval and interference explanations of forgetting, Atkinson and Schiffrin presented lists of 5 and 20 words and had their subjects recall the next to the last list presented. They used a list-intervention-list design in order not to confuse the effect of size of list with the number of words on the intervening list. They reasoned that it would make no difference in terms of recall ability if the intervening list was 5 or 20 words. The length of the list to be recalled was the variable that influenced recall ability. The significant results showed that words in lists 5 words long were recalled much better than words in lists 20 words long and that the intervening list did not appear to have much effect on retention ability. They also suggested that the subject "had . . . available appropriate cues (probably temporal in nature) to enable him to select probe information pertaining to the desired list (p. 90)." Their experiments reveal ". . . the importance of probe selection, a control process of the short term memory (p. 90)."

Probe selection depends not only on choosing the most efficient cue that will trigger recall but also on how the information was coded into memory. If, for example, a subject was asked to recall the nonsense

word dulcarnon and used individual letters to code the word into his memory and then selected the 'letters of the alphabet' as a probe to search his memory he would more than likely be unable to produce the word correctly because the search would be too broad. If the subject coded the word into memory as three syllables rather than 9 letters and then narrowed his memory search to 'letters of the alphabet' making the sounds of dul car non he would have a better chance of recalling the unfamiliar word because he would have regrouped the nine bits into three; a load that the immediate memory can easily accomodate.

Atkinson and Schiffrin's results correspond with the findings on the Word Memory Test in this study in that almost all subjects were able to recall lists of 4 and 5 words correctly. Only the better readers were able to recall longer word lists which may indicate that good readers do better on memory tasks of this nature than poor readers because the former may activate appropriate probes that will retrieve the information from the memory. Temporal, contextual, and associational cues may be some of the available types of probes that influence memory retrieval.

Generally it was found that students from the middle socio-economic school achieved higher mean scores on the tests of reading, memory and visual discrimination. An exception was reported on the Nonsense Word Test. The high achievers from the low socio-economic school achieved a higher mean score than the high achieving group from the middle socio-economic school. A difference that was significant beyond the .01 level.

The reversal of higher mean scores on the Nonsense Test could be explained in terms of teaching techniques or methods. If certain children were alerted to the use of syllables as a word analysis method, then the writer would predict better scores for them on the Nonsense Word Test than children who had little or no experience with syllabication analyses.

Null Hypothesis Three

There is no significant correlation (Pearson's r) between Gates-MacGinitie Reading scores and scores on the:

a) Nonsense Word Test;
b) Word Memory Test;
c) Letter Memory Test; and
d) Visual Discrimination Test.

A significant correlation was found between the Gates-MacGinitie reading scores and all of the memory and visual discrimination tasks at the .01 level. Therefore all parts of the Hypothesis were rejected.

Conclusion

The results of the tests indicate that all the memory and visual discrimination tasks reached a .01 level of significance in their correlation with the combined reading scores for the entire sample. Woychuk (1973) also found highly significant correlations between immediate memory for letters and words and reading scores for the third grade children in her sample.

These results also tend to support the conclusion reached in Hypothesis 1 which indicated that there was a relationship between a pupil's ability to retain visual stimuli and his reading achievement. The Nonsense Word Test correlated the highest followed by the Visual

Discrimination Test, Word Memory Test and the Letter Memory Test respectively.

Null Hypothesis Four

When the obtained means are compared using the test analysis or variance procedure, there is no significant difference between mean scores of the high, average, and low readers on the Visual Discrimination Test.

Significant differences beyond the .01 level were found between the high and average achievement groups; the high and low achievement groups and the average and low achievement groups. Therefore, Hypothesis 4 was rejected.

Conclusion

The significant differences were found between achievement groups when school populations were combined but not between mean raw scores for school one as compared to school two. Thus it appeared that socio-economic factors do not influence a child's ability to visually discriminate.

Visual discrimination seems to be a basic skill necessary for successful reading. Gibson (1965) in her extensive work with children reported that learning to differentiate graphic symbols was a basic phase in learning to read. In the present study visual discrimination ability was found to be the second best predictor of reading success.

III. Implications

This study contributed to the existing evidence confirming the relationship between short term retention ability and reading success

(Calfee & Jameson, 1971; Froehlich, 1970; Mackworth, 1972; Woychuk, 1973). Good readers did well on the visual retention tasks and poor readers performed poorly. Some implications are seen in terms of the components that contribute to retention; the coding and organization of visual information into memory.

In order to prevent visual information from being lost due to interference of incoming data, the reader must accurately pick out distinguishing features of the stimuli, attach a verbal label to it after he has regrouped or chunked the information into smaller bits, match it to long term memory and thus ensure that the information will enter the permanent store and be able to be retrieved. On the Nonsense Word Test many of the poor readers coded the words into memory letter by letter rather than by syllables. Failure to do so seemed to have caused the short term memory to become overloaded and thus the word was not recalled correctly. Reading programs containing ideas related to Miller's chunking technique could be emphasized; regrouping letters into syllables, syllables into words and words into phrases. The teacher could invent games using nonsense words to encourage children to depend on organizational techniques rather than individual units for recall aids. Using chunking procedures, remembering words by syllabic groups rather than letter by letter would ease the immediate memory's job and ensure that the complete word would be remembered.

The socio-economic factors did appear to influence performance on all the memory tests and the reading test. No definitive statement can yet be made about the short term store and its relationship to reading

achievement, but as was expected the measures used in this study did show a significant relationship in favor of the middle socio-economic school on the variables of immediate memory and reading achievement.

IV. Suggestions for Further Research

Short term memory for letters, words and nonsense syllables was studied to determine the existence of a relationship to reading achievement. A significant relationship was found. Letters and words are necessary to reading in the sense that petals are to a flower. But short term memory needs to be examined not only in its interaction with letters and words but also during the actual process of fluent reading.

Research should look at beginning readers to determine the role of coding and rehearsal in their recall processes. A training developmental study would be most informative. Would short term retention potential be realized if children in the primary grades were taught to look for distinctive features of letters and to 'chunk' stimuli?

The present study confirmed Woychuk's (1973) findings that letters were easier to retain than words. Could this be indicative of a certain developmental stage? As the child progresses through school, will his visual memory span for words improve? Further research sould be undertaken to answer these questions and to assess the immediate memory of children in the upper elementary grades, who because of more experience with reading may utilize memory processes differently.

Possibilities employing the Nonsense Word Test should be investigated to confirm the findings of the study and to establish the test's

reliability. The test could be used to assess organization and retention strategies in children younger and older than the present sample of grade four children. It may be found that organizational cues need to be specifically taught and not expected to come about naturally.

The study found that proficient readers organized incoming stimuli more efficiently than poor readers as shown by scores on the nonsense task. Using nonsense syllables a free recall design could be adopted rather than a serial order design in order to gain insights into better reader's recall strategies. Asking the children to verbalize their methods of recall in such a task may prove to be an alternate way of discovering the structuring procedures children use to lighten their memory load. It may also reveal efficient rehearsal and retrieval aids mature readers use.

Atkinson and Schiffrin (1971) demonstrated the importance of subject activation of correct search probes for word recall. They also postulated that the retrieval probes the subjects used in the list, intervening list recall task were temporal in nature. Further research could be implemented that would examine the use of memory probes and their nature during the act of meaningful reading.

The study reported, in Hypothesis 2b, a change in the dominant pattern of school 1 attaining higher mean scores than school 2. High reading achievers in school 2 reached higher mean scores on the Nonsense Word Test than did the same group from school 1 suggesting that an interaction between school and memory for syllables occurred. Further research is needed to go into school 1 and 2 and observe methods and talk with teachers

and review materials, whether they be commercial or teacher made, and try to isolate factors that may have contributed to the above mentioned phenomenon.

More indepth studies investigating socio-economic factors and academic success need to be employed. Significant differences were found to exist between mean scores for the two schools on the reading and word memory tests. Before any generalizations can be made the results of the study should be confirmed using a larger sample of low socio-economic children. In addition to using the Blischen Occupation Index Scale as a socio-economic measure, a case study approach could be used. This approach would yield information about the mother, the person with whom the child usually spends most of his time during the important cognitive forming years.

A possible follow up would be to determine if a short term visual memory training program using, for example, geometric forms, transfers to letters and positively affects reading achievement.

Concluding Statement

Barlettt, Hunt, Sperling and Underwood (Geyer, 1973) are just some of the reading researchers that include short term memory in their models of reading. It should be noted however that the models are still mainly theory and laboratory contained. The time has come for theory to be tested by field work. The present study was intended as a step in that direction.

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APPENDIX A

VISUAL DISCRIMINATION TEST

HUELSMAN WORD DISCRIMINATION TEST

FORM B - ALTA

NAME _____ SCHOOL _____

DATE TODAY _____ BIRTH DATE _____

(Year) (Month) (Day) (Year) (Month) (Day)

AGE _____ GRADE _____

(Years) (Months)

DIRECTIONS:

Look at the word in the left-hand side of the paper. Find this word amongst the groups of letters to the right and draw a circle around it.

EXAMPLE 1:

1.	the	eht	tle	the	thc	lhe
2.	look	lk	loo	ook	look	tooh
3.	in	in	ni	iin	ir	ih
4.	pig	pid	qig	pig	piig	pag
5.	is	es	iss	iis	sl	is

Begin on the next page. You will be given two minutes to do as many of the exercises as you can.

1.	house	nouse	huose	honse	touse	house
2.	funny	funnv	fnuuy	funry	lunny	funny
3.	fun	nuf	fnu	fun	lun	fune
4.	soon	sooh	soom	soon	scon	sune
5.	there	there	threr	tere	ther	ereht
6.	hen	nem	hon	uey	hen	neh
7.	pretty	pnetty	prettv	ytterp	typret	pretty
8.	new	nem	wen	new	ncw	uew
9.	under	under	derun	unber	unden	undr
10.	deep	deeq	deep	beed	beeq	decp
11.	flour	flour	fuor	fluor	flur	ourfl
12.	roar	raor	rore	ror	nora	roar
13.	twinkle	tminkle	twinkle	twiukle	twinhle	eltwink
14.	peeked	dekeep	deekep	qeeked	peekeb	peeked
15.	basement	basenemt	basoment	basmint	dasement	basement
16.	sweater	sweater	swetr	smeater	sweaten	shweater
17.	outfits	ouftits	notfits	outfits	ontfits	fitouts
18.	magician	nagiciam	magioian	magician	magiciau	majitian
19.	habit	habit	tibah	hadit	bahit	nabit
20.	celebration	celebrashun	celebratiou	celebration	celedtration	celetionbra
21.	inning	inuiug	inning	irring	lnning	inginn
22.	determination	determiuation	deterwination	betermination	determination	deminteration
23.	saucer	sauoer	sauecr	suacer	sancer	saucer
24.	applause	applause	applanse	applase	aqqlause	apphause

25.	absorbed	absorded	absonbed	absorbo	adsorded	absorbed
26.	deport	deport	deqort	depert	beport	deporh
27.	revolve	revolve	revolye	rewolve	vorelve	rovolve
28.	framers	sremarf	franers	frawers	framers	framens
29.	confessed	contessed	soufessed	confessed	comfessed	conkessed
30.	oblivious	obtivious	obliviaus	obliwious	oblivious	obliyious

NUMBER RIGHT_____ NUMBER WRONG_____ NUMBER OMITTED_____

LAST ITEM ATTEMPTED_____

APPENDIX B

MEMORY TESTS

Each word span, letter set and nonsense word was presented separately on cards. Only the scoring sheets are reproduced in this appendix.

Directions for the Nonsense Word Test

"I'm going to show you a card with a make-believe word on it. Look at it and when I take it away I want you to print exactly what you saw." After the child printed the word I asked him to pronounce it.

Scoring Sheet for Nonsense Word Test

varve	dulcarnon
thapes	nyanza
whelky	mujtahid
corah	endognath
pagrus	avantlay
hontish	santonin
tabret	austringer
tectum	zabeta
majuscule	inogen
teraglin	fucosan

Directions for the Word Memory Test

I'm going to show you a card with words on it. Look at it and when I take it away I want you to tell me exactly what you saw."

Name:_____

SCORING SHEET FOR WORD
MEMORY TEST

2a	help	and						
b	some	down						
3a	said	have	then					
b	that	come	you					
4a	can	her	now	run				
b	what	put	make	was				
5a	goes	like	work	off	say			
b	look	they	where	these	who			
6a	out	see	has	may	your	just		
b	west	give	here	could	why	came		
7a	this	our	soon	when	the	not	well	
b	were	take	its	those	been	for	must	
8a	find	did	will	but	are	saw	this	use
b	know	all	how	does	too	them	let	made
9a	get	would	she	that	his	with	had	there found
b	their	want	call	bay	which	him	from	live think

Directions for the Letter Memory Test were exactly the same except the word letter was substituted for words.

Scoring Sheet

LETTER MEMORY

	I	II	III	IV
2.	cq	xp	tv	kx
3.	bmr	dnv	hbd	mcw
4.	gzfs	jpyc	qvlt	pmkt
5.	ztbrc	qldnr	yfpqg	zqgfj
6.	bvnzygb	hxmjwd	wzsbxv	fpclms
7.	mzrfbsk	vqsjdch	dbxchqn	bdsvkph